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Number 1

THE EVOLUTION OF THE WEBS OF SPIDERS.

By J. H. COMSTOCK, Cornell University.

ABSTRACT.*

The making of its wonderfully regular web by an orb-weaving spider is a remarkable instance of specialization in habits; and correlated with this are equally remarkable specializations of structure. In the construction of their webs some spiders use several distinct kinds of silk, to produce which several distinct sets of silk glands have been evolved; and to manipulate this silk elaborate spinning organs have been developed.

The tracing of the steps by which these specializations have been evolved must be, in the present state of our knowledge, largely conjectural. We are forced to follow the method commonly employed in constructing genealogical trees. We will look for generalized conditions and from these attempt to trace the evolution of those more specialized.

A very little study by this method is sufficient to show that the web-making habit has not progressed in a single direct line. Beginning with the simplest type of web, we find that this type has been modified in widely different ways in the different families of spiders.

In our search for a starting point we gain no help from a study of other arachnids than spiders. Silk organs are of rare occurrence in the other orders of the Arachnida. It is said that the tailless whip-scorpions carry their eggs in a sac formed of a dark brown transparent material containing some threads; but the source of this material has not been described. It is well-known that the Pseudoscorpions spin silk; but the silk glands of these

*This address, delivered at the annual meeting in Washington, D. C., Dec. 27, 1911, was illustrated by lantern slides made from photographs of the webs described. These photographs are reproduced in a volume on the Arachnida of North America, "The Spider Book," by J. H. Comstock, now in press.

creatures are in the cephalothorax and open through the tips of one pair of jaws, the chelicerae, while the silk glands of spiders are in the abdomen and open through specialized legs at the opposite end of the body. Any genetic connection that there may be between these two sets of silk organs is too remote to throw any light on the particular problem before us. It is evident that in our study of the evolution of spider webs we are forced to confine our attention to the habits of spiders.

It is probable that the production of silk by spiders was not primarily evolved for the making of webs for capturing prey. The representatives of many families do not spin webs; and there is no reason to believe that these non-web-making families have descended from web-making forms. It seems more probable that the use of silk for making webs for capturing prey is a secondary or tertiary adaptation.

All spiders use silk in caring for their eggs. And it seems probable that this was the primary use of silk in this group of animals.

With some spiders, as *Pholcus*, only a little silk is used for this purpose, merely enough to fasten the eggs together in a ball; with some spiders the habit of making an elaborate egg-sac has been evolved; and many types of these egg-sacs exist. A single illustration of an elaborate egg-sac is sufficient for our present purpose. *Glyptocranium cornigerum* makes an egg-sac, with a vase-shaped outer covering, and fastens it to a twig with bands of silk in a manner which almost suggests human intelligence.

Spiders having acquired silk for the protection of their eggs have utilized it for other purposes, of which the making of webs for capturing prey is but one, and probably not the next one in the sequence of the different uses of this substance.

Many spiders that live in burrows in the ground strengthen the walls of their burrows by a lining of silk. Some of these, the well-known trap-door-spiders close the entrance to their nest by an elaborately constructed lid; and some build a turret over the entrance of their burrow. In the case of the turret spiders we have, I believe, from observations made on one that I kept in confinement in my office for several months, species that build a structure to facilitate the capturing of their prey, the turret serving as a watch tower from which insects invading the region near the nest can be more easily seen.

A much more elaborate provision for capturing prey made by a burrowing spider by prolonging the lining of its tube is the purse-web of *Atypus*.

Another remarkable device to aid in the capture of prey is made by one of the Dysderidæ, the species known as *Ariadna bicolor*. This spider lives in a silken tube built in the hole that serves as a retreat for the spider. This tube is suspended from a frame-work of threads, built at the entrance of the retreat, in such a way that any disturbance of the exposed parts of the nest is communicated to the occupant of the tube. From the frame-work at the entrance of the retreat there extends a series of radiating lines each of which passes over two or more piers which keep it suspended a short distance from the face of the supporting object; so that any insect walking on this object is sure to disturb one of these lines. The touching of one of the trap lines by an insect results like the touching of the spring of a "Jack-in-the-box." The spider comes forth with amazing swiftness, seizes the unlucky insect, and retreats with it instantly to its lair.

Let us pass now from this glance at unusual devices for the capture of prey to a study of the more common forms of spider webs.

How did the web-making habit arise? What were the steps by which the gap between the use of silk for the protection of eggs to its use in the construction of an elaborate web for the trapping of prey was bridged? With our present knowledge our answer can be only an hypothesis.

The most important step I believe to have been the acquiring of the habit of spinning a drag-line, the thread which most spiders spin wherever they go. The first drag-line may have been a thread which a spider was using in the construction of an egg-sac and by which the spider found it could drop from an elevated position to a lower one; from this all of the well-known uses of the drag-line could be evolved.

The complete history of the development of this activity is not so simple, however, as this statement might indicate. For there has been evolved a special kind of silk for use as a drag-line which differs in structure from that used in making egg-sacs and which is secreted by a distinct set of glands. But this is only one of several differentiations that have arisen; for now at

least seven different kinds of silk, each adapted to a special purpose, are spun by spiders.

The step from a drag-line to a web is not a great one. A spider spinning a thread wherever it goes would make a web if by chance it moved about in a limited space as in some nook in which it had taken up its abode. In such a web insects would be trapped, and thus might arise the habit of building webs for the purpose of trapping insects. The simpler webs made by spiders are irregular nets formed of the same kind of silk as that of which the drag-line is made. Such a web is made by *Pholcus*. It consists of a comparatively few threads spun without any regularity of arrangement.

A marked step in advance of the irregular nets of *Pholcus* is illustrated by the regular webs of the sheet-web-weavers, the Linyphiidæ. These are constructed of dry silk, the kind used for the drag-line, but they are of more or less definite form. That of *Linyphia phrygiana* is a flat sheet spun between the twigs of a shrub or a tree. *Linyphia pusilla* makes a horizontal platform between stems of grass and spins an irregular net above it to impede the flight of insects and cause them to fall upon the platform where they can be caught by the waiting spider. *Linyphia marginata* makes a filmy dome beneath which it waits to capture the insects that fall upon it after striking in their flight the irregular net spun above the dome, and *Linyphia communis* spins a bowl-shaped web with an irregular net above and a sheet below it.

A type of web resembling those of the Linyphiidæ in consisting largely of a sheet of silk, but differing in having a funnel-shaped retreat is made by certain members of the Agelenidæ of which the grass-spider, *Agelena neriia* is our most familiar example. A similar web is made in the basement of buildings and in other secluded places by *Tegenaria*.

All of these webs of which illustrations have been shown so far are made of the same kind of silk as that used for the drag-line. Their function is to impede the flight of insects giving the waiting spider time to capture them.

In the course of the evolution of the web-building habit there has been developed in many families of spiders organs for producing a second kind of silk, which being of a viscid nature is fitted to hold fast the entangled insect. The nature of this

viscid silk differs greatly in the different families producing it; and several types of it will be discussed before I close.

Among the spiders that spin a simple web are the members of the Theridiidæ of which the common domestic spider, *Theridion tepidariorum*, is a familiar example. The webs of this spider abound in the corners of neglected rooms, and are nearly as simple as those of *Pholcus*. They probably represent a slight elaboration of the primitive type.

In the family Theridiidæ is found the simplest form of viscid silk, this is merely a viscid liquid which is flung over the entangled prey. But although the silk itself is simple, correlated with its production there has been developed a specialized organ fitted for flinging the silk. This consists of a comb on the tarsus of the fourth legs.

The presence of this comb is a distinctive family characteristic. And the silk is produced by a set of glands, the lobed silk-glands, which have been found only in this family. The Theridiidæ, therefore, judged by their biological features and the correlated anatomical structures represent the tip of a distinct line of specialization.

In the other families of spiders that make use of viscid silk, there is produced a thread or a band that is viscid, and which forms a part of the web.

The webs in the construction of which two kinds of silk are used vary greatly in complexity of structure; and in different families the direction of specialization has been very different.

Two quite different lines of specialization can be recognized. In one group of families the foundation of the web, the part made of dry silk, is comparatively generalized in structure, while there has been evolved a highly specialized band for supporting the viscid silk. In another group of families the foundation of the web is very regular in form, that is to say, highly specialized, while the structure of the viscid silk has remained comparatively simple.

The first of these two lines of specialization, that in which the foundation of the web remains simple while the viscid silk becomes complex is found in a group of families known as the Cribellatæ. These are so called because they possess in addition to the silk glands possessed by other spiders a large number of small silk glands which open through a sieve-like plate, the cribellum, situated in front of the spinnerets. These glands

are supposed to secrete the viscid silk. Correlated with the presence of a cribellum is the presence of a comb of bristles on the metatarsus of the hind legs for manipulating this silk.

It should be noted in this connection that viscid silk is produced by at least three different sets of glands in different families of spiders. By the lobed glands in the Theridiidae, as already described; by the cribellum glands in the Cribellatae; and in the orb-weavers to be described later it is obviously produced by some other glands, as these spiders possess neither the lobed glands nor the cribellum glands. Apparently this very useful product has arisen independently at least three times within the order Araneida.

The viscid silk of the Cribellatae is a band-like structure whose form is partly determined by the combing action of the calamistrum. I have, therefore, termed it the hackled band.

The hackled band of one of the Dictynidae, that of *Amaurobius* may be taken as an example. This band consists of two parts; first, a supporting structure, which may be termed the warp; and second the viscid silk, which may be termed the wool.

The warp consists of four elastic threads, two of which are straight and two are curled. The wool is a narrow sheet of viscid silk, the edges of which are undulating. It is probable that each undulation was produced by a stroke of the cribellum.

While it is probable that the viscid silk, is spun from the cribellum glands, the threads constituting the warp are doubtless spun from spinning tubes situated on the spinnerets.

Turning to the webs of the spiders that spin a hackled band, we find great differences in the extent to which this band is used and also in the nature of the web of which it forms a part. It is easy to arrange these webs in a series which suggests a possible course of their evolution.

In the Dictynidae is to be found the simpler types in this series. Here the foundation of the web is irregular, its form depending very largely upon the situation in which it is built. The following will serve as examples:

Dictyna foliacea spins an irregular web of dry silk across the concavity of a leaf; and mingled with the dry threads are strands of viscid silk that have no regularity of arrangement.

Dictyna volucripes spins an irregular web of dry silk upon the stems of herbaceous plants; and upon this foundation stretches its hackled band in comparatively regular ladder-like

frets. In the webs of this species, the larger part of the web is made of dry silk. While the hackled band is doubtless the most efficient factor in the capture of insects, it is still a subordinate part of the web.

In the webs of *Dictyna sublata* the utilization of the hackled band is carried much farther. Here only so much dry silk is used as is necessary to support an elaborate lace-like sheet of viscid silk. This represents the quantitative extreme in the use of viscid silk.

A somewhat similar condition exists in the webs of a species of *Amaurobius* which spins its webs on cliffs.

In the webs of *Hypochilus thorellii* is found the same type of hackled band as in the webs of the Dictynidæ. I have been able to find no differences between the hackled bands of this spider and that of *Amaurobius*. But the web of *Hypochilus* is of regular form being lamp-shade shaped.

It is a remarkable fact that this spider which has retained the most generalized condition of its respiratory organs of all true spiders, being four lunged like the Tarantulas, should have attained the making of a regular web.

While the hackled bands of *Amaurobius* and *Hypochilus* are remarkable structures they lack much of representing the extreme of specialization in this direction. To see this we must examine the web of *Filistata*, a very common house spider in the South. Here the hackled band is composed of four distinct kinds of silk. But the web itself is more simple than that of *Hypochilus*.

Let us turn our attention now to the second of the principal lines of specialization of webs, that in which the attention of the spiders, to speak figuratively, has been devoted to perfecting the foundation of the web, while the viscid silk has remained comparatively simple. The culmination of this line is reached in the webs of the orb-weaving spiders.

There are two families of orb-weaving spiders, the Uloboridæ and the Argiopidæ. In the more typical webs of each of these families the most striking feature is the presence of a central, more or less orbicular part in which the frame-work of the web consists of radiating lines, which in the completed web support the viscid silk. The regular spacing of these radii gives the maximum of stability to the web with the minimum use of material. Most of the webs already described are built against

firm supports. The orb-weavers stretch their webs in mid-air between distant supports. Webs so exposed must be replaced frequently in part at least. It is important therefore that there should be an economical use of the dry silk.

It is only the orbicular part of the web that is renewed at frequent intervals. The outer foundation lines are a permanent investment and are carefully saved.

In the two families of orb-weavers the same type of foundation has been attained. The web of *Uloborus*, so far as its foundation is concerned, closely resembles an argioid web; but the nature of the viscid silk is very different. The Uloborids possess a cribellum and calamistrum and spin a true hackled band. This, however, is of a comparatively generalized type, the warp consisting of only two straight, elastic threads. The viscid silk is evidently less fluid than that of other families and consequently retains the form given it by the combing strokes of the calamistrum, that is a regular series of overlapping lobes.

A remarkable variation of the uloborid type of web is the triangular web of *Hyphotes*, which consists of only a sector of a web.

Passing to the webs of the Argiopidae, we find in the different subfamilies striking variations in the details of the structure of the orb, only a few of which can be mentioned here. But first let us examine the viscid thread.

In these webs where is found the most highly specialized frame-work of dry silk, there is found the simplest type of viscid thread. This consists of a double thread of elastic silk, upon which is poured the viscid silk. This viscid silk, is fluid, and almost immediately the surface tension of this fluid causes it to collect in drops, which are distributed along the elastic support in a very regular manner.

The simplest known orb-web is that of *Theridiosoma*, one of the Argiopidae. This has few radii and no hub; it is used, however, in a peculiar way, described long ago by Dr. McCook.

Before examining more perfect argioid webs, I wish to review briefly the steps in the building of an orb-web. These are so well-known that it is only necessary to enumerate them without a detailed description. First the outer frame-work is made; this is a permanent part of the web. In the open space surrounded by this frame-work the radii are then stretched. Upon the radii in the vicinity of the point where they converge

is built the hub of the web, the nature of which varies greatly in the webs of different divisions of the family. Extending from the hub a spiral line is spun upon the radii the turns of which are a considerable distance apart. As the function of this line is merely to hold the radii in place during the later stages of the web building, I have designated it the spiral guy line. This, like all portions of the web made up to this point is composed of dry silk. After the radii have been firmly stayed by the spiral guy line, the spider beginning at the outer edge of the orb and adds the loops and turns of the viscid line, destroying the spiral guy line as it progresses.

Frequently the remains of the spiral guy line can be seen as a series of regularly spaced dots on the radii of completed webs.

Great differences exist in the different webs of orb-weavers as to the relative amount of dry and viscid silk, one extreme is illustrated by the web of *Metepeira*; the other, by the web of *Cyclosa*.

In the webs of most orb-weavers, the entire orb is replaced frequently, only the outer foundation lines being a permanent investment. The spiral guy line is destroyed during the building of the web, the radii and viscid line are sacrificed when it is necessary to renew the orb.

But in the webs of *Nephila* we find that the web is so constructed that it is only necessary to renew the viscid line as it becomes injured or dry.

Here is attained the extreme of economy in the use of the dry silk, although the first investment is somewhat greater than in ordinary orb-webs. The orbicular part of an ordinary orb-web may be compared to a shack built for a day; the orb of *Nephila*, to a permanent structure built to stand during the life time of the occupant.

This difference is brought about by radical differences in the style of architecture. In the orb of *Nephila* the radii are forked, which results in the outer part of the orb being as firm as the central portion. The spiral guy line is attached to each radius lengthwise for a short distance; as this guy line is pulled taut it draws the radius out of its direct course; the course of each radius is, therefore, zigzag. The viscid line is looped back and forth between the turns of the guy line, and gives the web a banded appearance. When the web is repaired only the

old viscid line is removed, the radii and the guy line remaining intact.

An old female *Nephila* which I watched for a number of days at Miami, Florida, carried her economy in the use of silk a step farther. This individual removed the viscid thread of only one half of the web each night, repairing alternate halves on alternate nights.

During the period that this spider was under observation there was a very severe storm, five inches of rain falling in the course of a few hours. When the web was visited on the following morning it was found that it had been repaired throughout.

The steps in the perfecting of the webs of spiders briefly sketched in the preceding pages can be indicated in a tabular form as follows:

WEBS OF SPIDERS.

- | | | |
|-----|---|------------------|
| A. | Webs made by spiders that use only dry silk. | |
| B. | Irregular webs | Pholcidae |
| BB. | Regular webs. | |
| C. | The sheet webs | Linyphiidae |
| CC. | The funnel-webs | Agelenidae |
| AA. | Webs made by spiders that use both dry and viscid silk. | |
| B. | Webs consisting only of dry silk; the viscid silk being flung upon the prey. | Theridiidae |
| BB. | Webs consisting of both dry and viscid silk. | |
| C. | Webs consisting of a comparatively generalized foundation of dry silk and a highly specialized band supporting the viscid silk. | |
| D. | Warp of hackled band consisting of two straight and two curled threads. | |
| E. | Foundation of web irregular | Dictynidae |
| EE. | Foundation of web regular | Hypochilidae |
| DD. | Warp of hackled band consisting of four curled threads and a supporting cord. | Filistatidae |
| CC. | Webs consisting of a highly specialized foundation and a comparatively generalized viscid thread or band. | |
| D. | Webs containing a hackled band. | Uloboridae |
| DD. | Viscid silk not hackled | Argiopidae |
| E. | Radii and spiral guy line temporary. | Most orb-weavers |
| EE. | Radii and spiral guy line permanent. | Nephila |

NOTES ON THE EASTERN SPECIES OF CERKERIS.
(HYM. PHILANTHIDÆ.)

By NATHAN BANKS.

The species of *Cerceris* are among the prettiest of our entomophilous wasps; usually black, with bands and spots of yellow, of the general appearance of many species of *Crabro*. They are most abundant on flowers in July, some occur in June, and others as late as October. They are not especially shy, so are readily taken in the net.

The sexes are easily distinguished as the male shows seven abdominal segments, while the female has apparently but six. In the male at each side of the clypeal margin is a series of hairs set close together, forming a hair-lobe. In the females of many species the upper part of the clypeus is elevated into various shapes, according to the species. In the female the pygidial area is rather dull, and slightly transversely wrinkled or rugose, with few hairs, while in the male this area is strongly punctate, and hairy.

The characters of value for the distinction and identification of species are the coloration, the punctuation, the breadth of the face, shape of clypeal process in the female, of the clypeal margin and hair-lobes in the male, the length of the second joint of flagellum, and shape of the last joint, the distance of ocelli apart, the sculpture of the triangular area or enclosure at the base of the metanotum, the shape of the basal segment of abdomen, and the pygidial area at tip of body. In a few forms there is a tooth or ridge on each side of mesosternum. The number and spacing of the spines on the hind tibiæ is variable, but sometimes useful.

The color markings, as in other insects, are more or less variable; the spots on the metanotum are especially unstable, while the color of the hind femora is much more constant. All (except one) species have yellow spots or a band on the pronotum, and with one exception there is a yellow band on the second abdominal segment; the race of the male is wholly yellow. The color of the stigma of wings is quite constant, and of considerable systematic value.

The sculpture of the enclosure on metanotum is of great value, but there is some variation observable when one examines a series of one species; however, a considerable difference in

this sculpture seems to be of specific value. It is not always exactly alike in the sexes of a species.

In the tables I have used the coloration as far as possible, not because it is the most important, but because it is easily observable; and the more essential characters are described, or have been described by others.

Most of our species were described many years ago by Mr. Cresson; Packard treated them very briefly in his "Fossorial Hymenoptera"; a few new species have been added by others since, but no synoptic table of the Eastern species. Viereck and Cockerell tabulated the New Mexico species, and Swenk those of Nebraska. Schletterer has revised the European forms, and there are various other tables of local faunæ.

Many other species occur in the Eastern States, and I hope this table will serve to interest others in their collection.

Through the kindness of Dr. Skinner, I have examined the Cresson types in the American Entomological Society at Philadelphia, and wherever I did not already possess the species I have inserted it in the table according to the specimen in the Cresson collection bearing the label, which specimen I consider the type.

A few other species have been described from the Eastern States, principally by Smith, from Florida, and Georgia; his *C. rufopicta* is probably a good species allied to *C. rufinoda*, but much larger. Saussure has described two from Texas which are unknown to me.

MALES.

1. Hind femora pale on base, with a large black spot near apex; rarely spot on scutellum, post-scutellum yellow 19
2. Hind femora, mostly dark, mostly pale, or dark on base 2
3. Scutellum not spotted, but post-scutellum yellow; large species; enclosure not transversely rugose 3
4. Scutellum marked with yellow 5
5. Wings black; a large lateral spot on each side of face; scape of antennæ black; hind femora and stigma also black *fumipennis*
6. Wings sub-hyaline; face all yellow; scape of antennæ yellow beneath; hind femora mostly yellowish; stigma yellow 4
7. Band on second segment of abdomen not emarginate, legs II and III wholly yellow; no tuft of golden hair on last segment *gnara*
8. Band on second segment of abdomen emarginate in front, femora II and III black on base; apical segment with tuft of dense golden pubescence each side, basal joint of hind tarsus curved *venator*
9. Enclosure irregularly, transversely rugose; stigma blackish; hind femora mostly black; small, coarsely punctate species 6
10. Enclosure more or less smooth, or longitudinally striate 9
11. Basal segment of abdomen mostly reddish 7
12. Basal segment black, sometimes with a spot or band of yellow 8
13. Band on second segment of abdomen not emarginate *rufinoda*
14. Band on second segment emarginate in front *blakei*

8. Face wholly yellow..... *finitima*
Face with a large black spot each side between clypeus and base of the mandibles..... *finitima nigroris*
9. A yellow band or spots on the vertex; scutellum, post-scutellum, and the metanotum with yellow; legs almost wholly yellow; enclosure mostly smooth.....10
No spots nor band on the vertex.....11
10. First segment mostly yellow, second segment yellow on base; vertex with a band; antennae short; hair-lobes on clypeus very broad, not their breadth apart, clypeus truncate in front..... *morata*
First segment mostly black, second segment with yellow band on apical half; antennae normal; hair-lobes of clypeus very narrow, about twice their breadth apart, clypeus produced in middle below..... *zelica*
11. No band on the second segment of abdomen, which is wholly black; a band on first segment; no marks on postscutellum..... *insolita*
A band of yellow on second segment.....12
12. A tooth or ridge each side on mesosternum; antennae situated high above clypeus, the last joint thick; bands on abdomen subequal in width.....13
Neither tooth nor ridge on mesosternum.....15
13. Spine pointed downward, rather slender; no metanotal stripes, hind femora black..... *compar*
Spine directed backward, rather the tip of a raised ridge.....14
14. No metanotal stripes; hind femora with two black stripes..... *jucunda*
Metanotal stripes present, hind femora mostly yellowish..... *jucunda carolina*
15. Hind femora black, except at tips.....16
Hind femora pale, except at base.....17
16. Post-scutellum yellow, enclosed area partly yellow; abdomen mostly reddish; stripes on metanotum; head reddish; large species..... *ampla*
Post-scutellum black; antennae situated high above clypeus; stigma dark; small coarsely punctate species..... *kennicotti*
17. Scutellum and also post-scutellum spotted; last joint of antennae thick, barely longer than preceding joint.....18
Post-scutellum black; stigma yellowish; clypeus roundedly produced below, terminal joint of antennae longer than preceding, and concave within at tip..... *robertsoni*
18. Stigma dark; venter black; no band on basal segment; clypeus acutely produced below in the middle..... *compacta*
Stigma yellowish; venter ferruginous; first segment of abdomen often reddish..... *mimica*
19. Enclosure irregularly transversely rugose, or obliquely striate on sides, clypeus convex below in middle..... *clymene*
Enclosure more or less smooth or longitudinally striate.....20
20. Enclosure broad, nearly wholly smooth; lateral spots on first segment of abdomen.....21
Enclosure more or less plainly striate.....22
21. Clypeus swollen out transversely above middle..... *fasciola*
Clypeus evenly, faintly convex..... *alaope*
22. Clypeus flat, broadly truncate in front, with a transverse depression before tip; face only slightly hairy; first segment of abdomen with spots; enclosure finely striate; last ventral segment only slightly emarginate at tip..... *deserta*
Clypeus convex, rather rounded below, no transverse impression.....23
23. Enclosure with prominent median groove, first segment of abdomen much broader than long, unspotted, body rather finely punctate..... *chryssipe*
Enclosure without prominent median groove; first segment of abdomen hardly broader than long.....24
24. Rarely spots on first segment; enclosure striate all over, last ventral plate furcate at tip.....25
Spots on first segment; enclosure striate only on sides; venter spotted..... *prominens*
Spots on first segment; ornaments white; enclosure striate all over; venter with large spots or bands..... *nigrescens*

25. Enclosure finely evenly striate; abdomen very slender, first segment narrow; usually but four or five teeth above on hind tibia.....*imitatoria*
 Enclosure more coarsely striate; abdomen broader, more coarsely punctate; six to eight teeth above on hind tibia.....*clypeata*

FEMALES.

1. Clypeus with an elevation or process with a free apical edge.....2
 Clypeus without such elevation, although more or less swollen.....20
2. The clypeal process erect, and as long as broad.....3
 The clypeal process broader than long or not erect.....7
3. No yellow mark on first abdominal segment, and that on second not emarginate in front; enclosure longitudinally striate.....*clypeata*
 Some yellow on first abdominal segment.....4
4. Pronotum red all across, yellow on scutellum and post-scutellum, abdominal segments broadly yellow, enclosure striate all over.....*morata*
 Pronotum black, with yellow spots, scutellum not marked with yellow.....5
5. Band on second abdominal segment not emarginate in front; enclosure finely striate and only on the sides.....*gnara*
 Band on second abdominal segment strongly emarginate in front.....6
6. All femora blackish; no metanotal spots; segments beyond second hardly marked; basal joint of antennae black; enclosure mostly smooth.....*alape*
 Only fore femora partly blackish; spots on metanotum; all segments (except first) plainly banded; scape of antennae yellowish; enclosure mostly striate.
prominens.....8
7. First, and often second, abdominal segments mostly reddish.....8
 First abdominal segment black.....13
8. Enclosure transversely irregularly rugose; small species, head mostly black; stigma dark brown.....9
 Enclosure smooth, or punctate on sides; head mostly reddish; large species; stigma yellow.....10
9. Black beneath clypeal process; second segment and metanotum black.....*blakei*
 Yellow beneath clypeal process; second segment and metanotum partly reddish.....*irene*
10. Clypeal process very broad, broadly and deeply concave in front.....11
 Clypeal process not so.....12
11. Lateral angles of clypeal process not much elevated; abdomen pale only on base; wings dark.....*bicornuta*
 Lateral angles of clypeal process high, all abdomen pale; wings paler.....*frontata*
12. Clypeal process truncate in front; face very hairy.....*mimica*
 Clypeal process convex in front, a tooth on each side at its base; face not especially hairy.....*ampla*
13. Clypeal process acute; vertex all red, pronotum red across; metanotum nearly all red, enclosure smooth, scarcely punctate on sides; stigma yellow.....*firma*
 Vertex and pronotum not all red.....14
14. From the tip of clypeal process, which is not much elevated hangs a thin lamella, usually divided in middle.....15
 No such lamella present.....17
15. These lamellae or plates very small not half the width of clypeal process, which is low; spots on scutellum, band on second abdominal segment very broad, not emarginate; enclosure smooth in middle, faintly striate on the sides.....*robertsoni*
 Lamellae reach almost wholly across the tip of clypeal process.....16
16. Clypeal lamella not emarginate in middle; spots on scutellum, none on post-scutellum; hind femora more or less blackish; enclosure mostly smooth.
mandibularis
 Clypeal lamella emarginate in middle, practically divided; scutellum and post-scutellum both marked with yellow, hind femora (as well as most of others) yellowish; enclosure strongly rugose.....*compacta*
17. Scutellum marked with yellow; usually a mark on first abdominal segment. 18
 Post-scutellum only with yellow.....21

18. Metanotum with yellow stripes; hind femora all reddish yellow, spot on clypeus each side at base of mandibles; clypeal process sub-conic; enclosure smooth in middle, punctate on sides..... *zelica*
No metanotal stripes; hind femora blackish.....19
19. Narrow bands on all segments; clypeal process small; enclosure smooth in middle.....*compar*
All segments not banded, clypeal process plainly truncate in front.....20
20. Very coarsely punctate; no yellow on interantennal ridge, band on fourth abdominal segment, small species, a small tooth or ridge on mesosternum each side.....*Kennicotti*
Enclosure strongly transversely, irregularly rugose; basal segment of abdomen not spotted.....22
21. Enclosure smooth in part, or longitudinally striate.....23
22. Clypeal process twice as broad as long, yellow beneath, stigma brownish.
halone
Clypeal process nearly as long as broad, black beneath; stigma yellowish.
clymene
23. Basal abdominal segment not spotted clypeal process nearly square; stigma yellowish; enclosure coarsely striate.....*chryssipe*
Basal segment spotted.....24
21. Spot at base of mandibles, usually also on metanotum.....25
21. No spot at base of mandibles, clypeal process not or but little narrowed in front.....27
25. Marks white; enclosure striate all over; clypeal process emarginate in front.
nigrescens
Marks yellow; enclosure mostly smooth or clypeal process narrowed in front and not emarginate.....26
26. Clypeal process narrowed in front and almost rounded below; enclosure finely striate, except at tip, hind femora yellowish.....*psamathe*
Clypeal process broad, emarginate in front, enclosure almost wholly smooth, hind femora black at tips.....*fasciola*
27. Angles of clypeal process very sharply produced; enclosure strongly striate; spots on first abdominal segment connate.....*dentifrons*
Clypeal process only slightly emarginate in front.....28
28. Enclosure large, mostly smooth; no metanotal marks; stigma yellowish; clypeal process not emarginate.....*deserta*
Enclosure finely striate; stigma brownish; clypeal process emarginate in front; scape of antennae black.....*arelate*
29. Wings wholly black; face with three transverse pale spots, post-scutellum yellow, scutellum unmarked, band only on second abdominal segment, enclosure broad and smooth.....*fumipennis*
Wings not wholly black.....30
30. Second segment of abdomen unmarked.....*insolita*
Second segment of abdomen banded.....31
31. Enclosure transversely rugose; stigma dark brown; spots on scutellum and band on post-scutellum yellow; small, coarsely punctate species.....32
Enclosure smooth in part or longitudinally striate; stigma yellowish; first segment of abdomen with a band.....34
32. First segment of abdomen red; band on second segment usually not emarginate in front.....33
First segment of abdomen black, usually with yellow mark; band on second segment usually emarginate in front.....*finitima*
33. Metanotum black.....*rufinoda*
Metanotum reddish (except enclosure).....*rufinoda crucis*
34. Scutellum, but not post-scutellum yellow; clypeus all yellow; band on basal segment of abdomen; hind femora blackish; enclosure punctate on sides.
catawba
Post-scutellum, but not scutellum, yellow; yellow spot on clypeus; basal segment of abdomen spotted; hind femora yellowish, enclosure mostly smooth
fulvipediculata

Cerceris ampla n. sp.

♀ Reddish; face yellow; tips of mandibles black; vertex reddish, two elongate yellow spots, and a long yellow patch behind the eyes; antennae rufous on basal half, rest black; large spots on pronotum, tegulae, about five large spots on pleurae; scutellum and post-scutellum, metanotum on sides, and the enclosure, yellow; first segment of abdomen mostly yellow, others with apical yellow bands, very broad on sides of second segment, fourth, fifth, and sixth segments mostly black; venter red on base, black beyond, apical segments with broad apical band of short tawny hairs; legs mostly yellow and rufous, hind femora black behind, and a spot on the middle tibiae. Wings fuscous on anterior half, stigma yellowish. Body coarsely, confluent punctured. Clypeal process prominent, apex rounded, (as figured) a lateral process on each side-lobe, not erect, and seen from the side as broad at tip as at base; lower edge of clypeus with two teeth near the middle; ocellar triangle very low, rather forming a curved line; enclosure swollen, broad, smooth in the middle, punctate on the sides; first segment of abdomen with nearly parallel sides, hardly one-half as wide as the second segment; pygidial area about twice as long as broad, the sides nearly parallel, but a little bowed outward near base.

The male is colored similar to the female, but more black, especially on the thorax, the metanotum mostly black, side stripes yellow, and a spot on the enclosure, front and middle femora above and hind femora mostly black, tibia black on apical half. Middle joints of antennae very short, last two joints very long subequal, the last curved, but not tapering; the hair-lobes scarcely more than breadth apart; pygidial area scarcely as long as broad, the apex undulate.

Length ♀ 22 mm., ♂ 18 mm.

From Fedor, Lee County, Texas. (Birkmann) Mr. Rohwer had given this name, but has not published a description. It is related to *hebes* Cam., *bidentata* Say, and *macrosticta* Vier. & Ckll., but differs in several points from each of them.

Cerceris bicornuta Guérin.

From Southern Pines, N. Car. The pygidial area of the female is two and one-half times as long as broad, and very much narrowed near base. It is allied to *C. frontata* by shape of the clypeal process.

Cerceris frontata Say.

This is a Western species, but was described from "Arkansas"; I have it from Palmerlee, Arizona. The pygidial area of female is of the same shape as in *C. ampla*. The radius of the wing is black until a little before the stigma, other veins yellowish.

***Cerceris fumipennis* Say.**

From Washington, D. C., Falls Church, Va., and Fedor, Texas. The pygidial area of the female is about two and a-half times longer than broad, broadest near base, and much narrowed to the tip. In male this area is more than twice as long as broad, the sides nearly parallel, and as broad at tip as anywhere. The hair-lobes are nearly one and a-half times their breadth apart; the last joint of antennæ is as long as preceding, slightly tapering and somewhat curved.

***Cerceris mandibularis* Patton.**

From Washington, D. C., and Falls Church, Va., in June. It is allied to *C. compacta* by structures of clypeus; the enclosure is very broad and smooth; the pygidial area two and one-half times longer than broad, tip about one-half as broad as in middle, the sides strongly curved, the base very narrow.

***Cerceris robertsoni* Fox.**

From Falls Church, Va., and Southern Pines, N. Car., in June and July. The pygidial area of the female is about two and a-half times longer than broad, broadest near base, about one-half as broad at the rounded tip, the sides curved. In the male it is about twice as long as broad, and plainly narrower at tip than elsewhere; the last joint of antennæ is as long as the penultimate, a little curved, but not concave behind; the hair-lobes are fully three times their breadth apart; the clypeus very hairy.

***Cerceris compacta* Cress.**

This is the most common species in Virginia, and occurs from June to September; also from Southern Pines, N. Car., and Lee County, Texas. The pygidial area of female is nearly twice as long as broad, broadest near base, narrow at tip, the upper part of sides strongly curved. In the male this area is hardly one and a-half times longer than broad, broadest at base; the last joint of antennæ is barely longer than the preceding, tapering, but not concave behind. The hair-lobes are fully twice their breadth apart, the lower part (in fact all) of face is very hairy; in both sexes the stigma is plainly darker than the cell beyond it. In the female the front tarsi are broader and more flattened than in any other species. Cameron's figure shows that *C. mexicana* is perhaps the same species.

***Cerceris chrysipe* n. sp.**

♀ Similar in most respects to *C. clypeata*, but the clypeal process is broader than long, the abdomen is rather broader and the punctuation less coarse; the enclosure is raised in middle with a median furrow, and very coarsely striate on sides.

♂ The male is similar to *C. clypeata* in markings and clypeus, but has the abdomen very much broader, and with finer punctuation; the enclosure more coarsely striate than in *C. clypeata*.

From Falls Church, Va., in July, on *Cicula*.

***Cerceris dentifrons* Cress.**

The type from Illinois has the clypeal process broad, and the lateral angles are very strongly produced; more so than in any other species seen from the Eastern States.

***Cerceris clypeata* Dahlbom.**

From Ithaca, N. Y., and Falls Church, and Glencarlyn, Va., in June and July. The pygidial area of the female is more than twice as long as broad, the sides sub-parallel, and the tip only a little narrower than the base; in the male this area is scarcely one and a-half times as long as broad, with broad, truncate tip; the hair-lobes are fully twice their breadth apart, I have restricted this species more than Cresson or Packard, with a definite clypeal process.

***Cerceris deserta* Say.**

From Sea Cliff, N. Y., and Falls Church and Glencarlyn, Va., in June, July and September; the September specimens are all males. The pygidial area of female is two and a-half times longer than broad, the sides nearly parallel, and the tip hardly narrowed. In male this area is a little over twice as long as broad, sides parallel; the hair-lobes are very small, fully three times their breadth apart.

***Cerceris arelate* n. sp.**

♀ Black; mandibles all black, barely a trace of pale near base; a spot on clypeal process, a large spot each side on face, tegulae, post-scutellum, two spots on basal segment (nearly connected), narrow, emarginate bands on other segments, yellow; legs yellow, front and middle femora black, hind femora black on base, inner tip of hind tibia, and most of hind tarsi blackish; flagellum somewhat yellow at base beneath; scape, interantennal carina, and pronotum black, venter also black, unspotted; wings fumose, darker on costal apex, stigma yellowish. Clypeal process moderately elevate, much broader than

long, seen from in front the edge is concave; lateral ocelli as near to eyes as to each other; enclosure large, striate, the lateral stripe rather oblique; abdomen not very broad, basal segment more than one-half width of second segment; pygidial area about two and one-fourth times longer than broad, nearly twice as broad at base as at tip, but the sides are nearly straight; body moderately punctate.

Length 10 mm.

From Great Falls, Va., 20 June. By black pronotum, and scape it is quite distinct from allies, and omitting these it will not fit any other form.

***Cerceris morata* Cress.**

Males from Fedor, Lee County, Texas, (Birkmann). The pygidial area is about one and a-half times longer than broad, broad at base, and fully twice as broad in middle as at the narrow tip. The last joint of antenna is longer than the penultimate, but not concave behind; the hair-lobes are exceedingly large, only about one-third their breadth apart. The second segment is yellow in front, instead of behind as usual. I have figured the clypeal process of the female from the type.

***Cerceris prominens* n. sp.**

♀ Black; base of mandibles, a large spot each side between antennae and eyes, spot on clypeal process, dot behind eyes, two spots on pronotum, tegulae, metanotal stripes, two spots on first segment of abdomen, a broad band, deeply, triangularly indented, on second, narrow bands on next three segments, yellow. Legs yellow, front coxae, and basal part of femora, blackish; rather dark on base of mid femora and tip of hind tibia, hind tarsi dusky; scape and first two joints of flagellum beneath yellowish. Wings dusky, stigma yellow. Body coarsely punctate, clypeal process a little longer than broad, nearly square, enclosure with a deep median groove, and lateral somewhat oblique striae; pygidial area two and one-fourth times as long as broad, broadest near base, much narrowed at tip (not as narrow as in *C. clypeata*). Venter black, finely punctate.

♂ With face all yellow, no metanotal marks, that on second segment not indented, front and mid femora black behind, hind femora and tibia black on apical half, last joint of antennae fulvous; clypeus apparently rounded below, but with three black teeth; hair-lobes about one and a half breadth apart; second joint of flagellum much longer than third, apical joint scarcely longer than the preceding, curved; enclosure smooth in middle, striate on sides; pygidial area about twice as long as broad, scarcely broader in the middle, apical corners rather prominent.

Length 13 mm.

From Falls Church, Va., September and October.

***Cerceris firma* Cress.**

I have seen only the types, these (females) have a small almost acutely pointed depressed clypeal process, partly obscured by hair; it is shown in the figure.

***Cerceris imitatoria* Schlett.**

Specimens from Falls Church, Va., in June, I have placed doubtfully as this species, which in nearly all structures seems almost identical with *C. clypeata*.

***Cerceris nigrescens* Smith.**

From Ithaca, N. Y., and Southern Pines, N. Car. The pygidial area of the female is figured. The male has not been described, so the following is given:

♂ Black, basal part of mandibles, face, two spots on pronotum, tegulae, post-scutellum, a small spot each side on the metanotum, two spots on basal segment, bands on following segments, all broader on sides, pale yellowish. Venter black, second, third and fourth segments with pale bands; legs pale yellowish, front and mid femora more or less black, mostly behind, hind femora with black apical spot, also on hind tibia, hind tarsi dusky. Scape of antennae yellow, black above, flagellum more or less fulvous beneath. Wings nearly hyaline, dark on costal apex, stigma yellow. Face and rest of body very finely punctate, vertex more coarsely punctate; second joint of flagellum short, but little longer than the third, apical joint smaller than the preceding joint, curved; lateral ocelli nearer to each other than to eyes; clypeus rounded below, with three blunt, black teeth; hair-lobes three times their breadth apart; enclosure rather broad, striate; pygidial area small, two and one-eighth times as long as broad, tip faintly rounded; about five or six spines on hind tibia.

Length 8.5 mm. to 10 mm.

From Ithaca, N. Y., and Southern Pines, N. Car., (Manee).

Mr. Rohwer has informed me that the type of Smith has the clypeal process truncate, and differs somewhat in other points; however this is the *C. nigrescens* of Cresson and Packard, and so I leave it until it is shown that there is another species more closely agreeing with the type, or the limits of variation in the shape of the clypeal process are better known than at present.

***Cerceris clymene* n. sp.**

♀ Black; base of mandibles, spot above their base, sides of face, upper surface (except tip) of clypeal process, dot behind eye, two spots on pronotum, tegulae, post-scutellum, a broad band on second segment of abdomen, a narrow line on each of next two segments, and the fifth

with a spot each side, yellow. Interantennal ridge black, scape yellow, black line above, first and second joints of flagellum partly rufous; wings dark, darker on costal apex, stigma yellow; venter black; legs pale, coxae wholly and femora partly black, hind tibia dusky at tip, hind tarsi dusky. Body densely and quite coarsely punctate, venter nearly smooth. Clypeal process a little broader than long, emarginate in front; clypeus below the process shows a ridge each side; second joint of flagellum much longer than third; lateral ocelli plainly nearer to each other than to the eyes; enclosure coarsely transversely rugose; abdomen quite broad, the segments not much narrowed at base, the basal segment much broader than long; pygidial area a little more than twice as broad as long, sides sub-parallel; six or seven spines on hind tibiae, sub-equally spaced. One specimen shows a small spot each side on basal segment of abdomen.

♂ Similar to female, face all yellow, large metanotal spots, small spot each side on basal segment, last segment more plainly banded than in female. Clypeus with three blunt, black teeth below on middle; hair-lobes about one and a half their breadth apart; last joint of antennae not as long as preceding, curved, and tapering; enclosure with oblique striae on lateral angles, elsewhere transversely rugose; abdomen rather broad, segments but little constricted at base; pygidial area hardly twice as long as broad, sides parallel, apex truncate, surface coarsely punctate. Legs with front and middle femora largely black, hind femora with large black spot, but the base pale, hind tibia blackish each side near tip, tarsi blackish.

Length ♀ 11 mm. ♂ 10 mm.

From Glencaryn, Va., 23 June (*Ceanothus*), and Falls Church, Va., 30 July.

***Cerceris psamathe* n. sp.**

♀ Black; basal half of mandibles, spot above base of mandibles, clypeal process above, spot each side on face, interantennal carina, dot behind eye, two spots on pronotum, tegulae, post-scutellum, stripes on metanotum, two spots on basal segment, rather broad and broadly emarginate bands on other segments, yellow; band on second segment not much broader than others; legs mostly yellow or rufous, anterior and middle femora black at base, spot near tip of hind tibia, and tarsi dusky; antennae blackish above, except at tip. Body very finely punctate (not near as coarse as in *C. nigrescens*), clypeus as figured; enclosure large, finely striate; basal segment of abdomen scarcely one-half the width of second segment; pygidial area long, plainly constricted near tip.

Length 11 mm.

From Lee County, Texas, (Birkmann). *C. convergens* Vier. & Ckll., from New Mexico has a similar pygidial area, but is said to be coarsely punctate, with spots on scutellum, etc. The description of *C. novomexicana* agrees very well, except the constriction of pygidial area is not mentioned.

C. occipitomaculata was described from one male from Kansas; I have not seen it, but it belongs in this group of the genus and was compared with *C. nigrescens*. The female, above described, is near to *C. nigrescens*, and, barring sexual characters, agrees fairly well with Packard's description, however there is some doubt. A female specimen named *C. occipitomaculata* in the Cresson collection is very near to *C. deserta*; until the female of *C. occipitomaculata* is surely known it is better to consider this form new.

***Cerceris gnara* Cress.**

A pair from Lee County, Texas, (Birkmann). The pygidial area of the female is a little more than twice as long as broad, broadest near base, the sides nearly straight, and the tip not much narrowed and rounded. In the male this area is not quite twice as long as broad, with parallel sides and truncate tip; the hair-lobes are about once and a-half their breadth apart; the last joint of antennae is longer than the penultimate, curved and concave behind.

***Cerceris alaope* n. sp.**

♂ Face, two spots on pronotum, tegulae, post-scutellum, two spots on basal segment of abdomen, a broad band, emarginate in front on second segment, and narrower bands on following segments, pale yellow. Antennae black above, scape beneath yellow, flagellum fulvous beneath. Wings fumose, darker on tip, stigma dull yellowish. Legs pale yellow; front and mid femora, apical part of hind femora, and apical half of hind tibia, black; venter black, a few pale spots each side. Clypeus very slightly evenly convex, almost flat, not swollen above, lower margin truncate, upper edge slightly rounded, coarsely punctate; hair-lobes rather narrow, fully twice their breadth apart; second joint of flagellum much longer than the third, apical longer and narrower than the preceding, and somewhat curved; lateral ocelli about as near to eyes as to each other; enclosure very large, smooth, with a median groove and indistinctly striate on base; abdomen (including basal segment) much broader than in *C. fasciola*; pygidial area hardly twice as long as broad, truncate at tip, sides parallel, rather densely punctate, and very hairy; spines on hind tibia, seven or eight, evenly spaced.

Length 10 mm.

♀ Similar to male; clypeal process black across tip; large spot each side on face, spot at base of mandibles, extreme base of mandibles, spot behind eyes, yellow; flagellum mostly fulvous, abdomen marked as in male, but the bands more narrow, and that on second segment is more deeply emarginate; all femora mostly black, but pale on tips; clypeal process erect, longer than broad; enclosure large, and mostly smooth as

in the male; pygidial area about two and a fourth times longer than broad, sides sub-parallel, but narrowed at tip.

From Falls Church, Va., 5 June on *Ceanothus*. Related to *C. fasciola*, but with broader abdomen, different clypeus, and more coarsely punctate, especially on metanotum and abdomen.

***Cerceris fasciola* Cress.**

Described from Texas; I have a pair from Lee County. The pygidial area of the male is about twice as long as broad, the sides parallel, the tip truncate. The hair-lobes are plainly more than twice their breadth apart. The female in structure is near *C. nigrescens*, but the smooth enclosure and mostly yellow legs will easily separate it.

***Cerceris insolita* Cress.**

From Falls Church, Va., 30 July, and Lee County, Texas, July. In the male the hair-lobes are very broad, so that they are hardly more than one-half their breadth apart; the clypeus shows two little black spots at apex; the last joint of antennae is thick and short; the pygidial area is less than twice as long as broad, the sides parallel, tip truncate, surface coarsely punctate, but scarcely hairy; on the venter the third segment shows a yellow band. *C. obsoleta* of Mexico is very close to this species.

***Cerceris zelica* n. sp.**

♂ Black, basal part of mandibles, face (except little black spot at tip of clypeus) inter-antennal streak nearly reaching the ocelli, two spots on vertex, spot behind eye, pronotum all across, tegulae, spot beneath wings, scutellum, and spot on post-scutellum, broad stripes on mesonotum, median spot on basal segment of abdomen, bands on other segments, yellow. Band on second segment broader than others, all narrowed in middle; venter with spots each side, some connected by lines; scape yellow, first joint of flagellum brown, rest rufous, but black above beyond base; legs all yellowish. Body coarsely punctate; clypeus rounded in middle below, hairy each side, truncate above; hair-lobes fully three times their breadth apart; antennae high above clypeus; second joint of flagellum longer than the third, apical not much longer than the preceding, tapering, not concave within. Enclosure mostly smooth, a median groove, and punctate on sides; abdomen rather broad, the segments strongly constricted at base, first segment plainly broader than long; pygidial area once and two-thirds as long as broad at base, narrowed to tip, which has prominent angles, surface coarsely punctate; venter nearly smooth, punctate a little on sides.

Length 12 mm.

Fedor, Lee County, Texas, 7 June, (Birkmann). The female which seems to agree in all essential points with the male is described as follows:

♀ Black, most of mandibles, spot at base of mandibles, all of clypeal process, above and below, oblong spot each side on face, inter-antennal mark, two spots on pronotum, tegulae, scutellum, stripes on metanotum, all segments of abdomen with bands, yellow. Band on last segment of abdomen very narrow, on second quite broad, scarcely emarginate, legs yellowish, coxae and bases of femora blackish. Body not very coarsely punctate; clypeal process small, sub-conic; lateral ocelli as near to each other as to eyes; enclosure mostly smooth, punctate on sides; the abdomen moderately broad, the segments not much constricted at base; pygidial area about three times as long as broad, narrowed at base; hind tibia with about seven spines, nearly evenly spaced; second joint of flagellum plainly longer than third. Wings not very dark, except tip, stigma yellowish.

Length 12 mm.

From Lee County, Texas, 7 July (Birkmann).

Cerceris halone n. sp.

♀ Black; a small spot at base of mandibles, spot beneath clypeal projection, one on its upper surface, a large triangular mark on each side of face, two spots on the pronotum, tegulae, post-scutellum, a broad band (emarginate in front) on second abdominal segment, an elongate lateral spot each side on third segment, and narrow bands on the next two segments, yellow; basal two joints of flagellum yellowish beneath; legs yellow, coxae, and front and mid femora black, hind femora black behind, (except tip), black at inner tip of tibia, and the hind tarsi mostly blackish; venter black. Body densely and rather coarsely punctate. Clypeal process small, from above it is about three times as broad as long, and emarginate in front, from in front it shows as an even arch, above it is transversely convex, and very hairy at sides; lateral ocelli a little nearer to each other than to eyes; enclosure not very coarsely but very irregularly and mostly transversely rugose. Abdomen moderately slender but basal segment is much broader than long; pygidial area about two and one-fourth times longer than broad, sides sub-parallel, but narrowed at tip, and margined with much blackish hair; venter rather finely punctate; hind tibia with seven not evenly spaced spines. Wings dusky, darker at tips, stigma yellowish.

Length 12 mm.

From Falls Church, Va.

Cerceris fulvipediculata Schlett.

This is the *C. fulvipes* Cress., the name being preoccupied. From Falls Church, Va., 4 September. The pygidial area of the female is fully three times longer than broad, the sides practically parallel, but the tip rounded, and a little more narrow than the base.

***Cerceris kennicotti* Cress.**

This is a very common species in northern Virginia, and also occurs in Texas. The pygidial area of the female is about twice as long as broad at base, and fully twice as broad near base as at the truncate tip. The male has the hair-lobes fully three times their breadth apart; the pygidial area is hardly twice as long as broad, with curved sides, the tip almost one-half narrower than base.

***Cerceris compar* Cress.**

From Ithaca, N. Y., and Falls Church, Va.. The pygidial area of female is two and a-half times longer than broad, broadest at middle, and much narrower at base than at tip. The male has hair-lobes so large that they are less than their breadth apart; the pygidial area is not twice as long as broad, and more narrow at base than at tip, its surface very coarsely pitted except near tip. The spines on mesosternum easily separate the male.

***Cerceris catawba* n. sp.**

♀ Black, face and clypeus pale yellow, on the sides extending above antennae and a line between them; antennae yellowish or reddish beneath, dark above, an elongate spot each side on pronotum, the scutellum, a stripe each side on metanotum pale yellow; all segments of abdomen with complete posterior yellow bands, that on the first segment as wide as that on second, but the latter concave in front; legs yellowish, the femora black on basal half or two-thirds, the hind tibiae black at tip, the mid tibiae with dark streak behind, the hind tarsi dusky, the basal joint only at tip. Wings smoky, darker in marginal cell and beyond, the stigma brown. Clypeus of female not elevated, produced below in middle, but truncate at tip, above broadly truncate; enclosure smooth in middle punctate on sides, pygidial area two and one-half times as long as broad, nearly as broad at apex as in middle, but narrowed at base.

♂ Similar to female; with clypeus slightly convex, sparsely, coarsely punctate, lower margin slightly rounded but with a black, truncate edge; hair-lobes broad, but about their breadth apart; antennae high above clypeus, second joint of flagellum short, barely longer than the third, apical joint thick, but a little longer than the preceding; pygidial area twice as broad as long, sides subparallel, tip truncate, surface with a few coarse punctures; last ventral broadly emarginate at tip.

Length 9 mm.

From Southern Pines, N. Car., June, (Manee).

***Cerceris jucunda* Cress.**

From Fedor, Lee County, Texas, 6 April (Birkmann). The hair-lobes of male are scarcely more than one-half their breadth apart. The pygidial area is narrower than in *C. compar*, and more narrowed at base; the last joint of the antennæ is as long as preceding joint, but thick, and not curved.

***Cerceris jucunda carolina* n. var.**

From Southern Pines, I have specimens a little larger than the type, with a rather broad head; there are large yellow stripes on the mesonotum, and the pygidial area is hardly narrowed at base; the mesosternal processes are of the same shape as *C. jucunda*. With a larger series it will perhaps prove a distinct species.

***Cerceris blakei* Cress.**

From Falls Church, Va., 28 July, and Southern Pines, N. Car., June and July. In the female the clypeal process is more erect than in *C. irene*, the pygidial area of female is fully twice as long as broad, the sides convex.

***Cerceris rufinoda* Cress.**

From Falls Church, Va., August, and Fedor, Texas, June. The female from Falls Church has the face black, except a large spot each side; the pygidial area is long, very narrow at base, sides convex, and tip truncate; in the male the pygidial area is short, and not narrowed at base; the clypeus convexly rounded below as in *C. finitima*, the hair-lobes nearly one and a-half times their breadth apart. The variety *C. rufinoda crucis* Vier, and Ckll., comes from Lee County, Texas.

***Cerceris irene* n. sp.**

♀ Face wholly yellow; scape yellow, barely reddish above, flagellum rufous beneath, blackish above; vertex with a reddish spot each side, and reddish behind, and with a yellow spot behind the eyes; large spots on pronotum, tegulae, large spots (almost contiguous) on the scutellum, and band on the post-scutellum, yellow. Mesonotum mostly reddish, with a black patch each side, meso- and meta-sternum reddish. First and second segments of the abdomen reddish, latter with apical yellow band and moderately wide bands on the next three segments; venter reddish at base; legs wholly reddish yellow; wings fumose, stigma almost black. Body very coarsely punctate; clypeal process but little elevated, apex nearly truncate, and reddish; antennæ situated

more than the diameter of sockets above the clypeus; second joint of flagellum but little longer than the third; lateral ocelli scarcely nearer to each other than to eyes; enclosure coarsely, mostly transversely rugose; basal segment of abdomen hardly one-half the width of the second segment; pygidial area twice as long as broad, sides strongly convex, broadest in middle, and narrower at tip than at base; hind tibiae with about seven spines above, nearly evenly spaced.

Length, 7 mm.

From Fedor, Lee County, Texas, 25 June, (Birkmann).

***Cerceris finitima* Cress.**

From Falls Church, Va., Southern Pines, N. Car., and Lee County, Texas. The female pygidial area is very slender as figured; in the male it is about twice as long as broad, about equally broad at base and tip, with slightly curved sides; the last joint of the antenna is thick and heavy; the hair-lobes are about once and a-half their breadth apart.

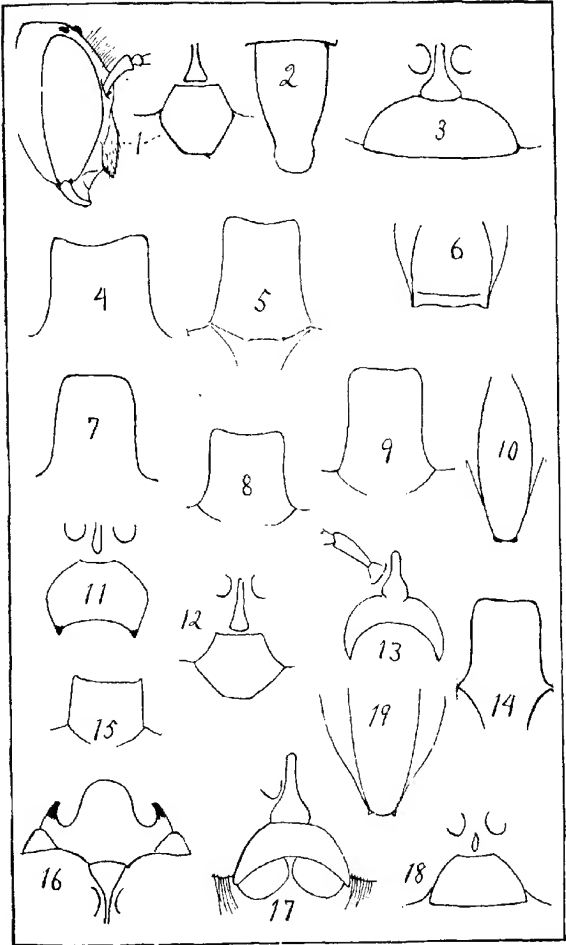
***Cerceris finitima nigroris* n. var.**

This is a variety of the male which is larger than the type, and with a large black spot each side of clypeus above the base of mandibles.

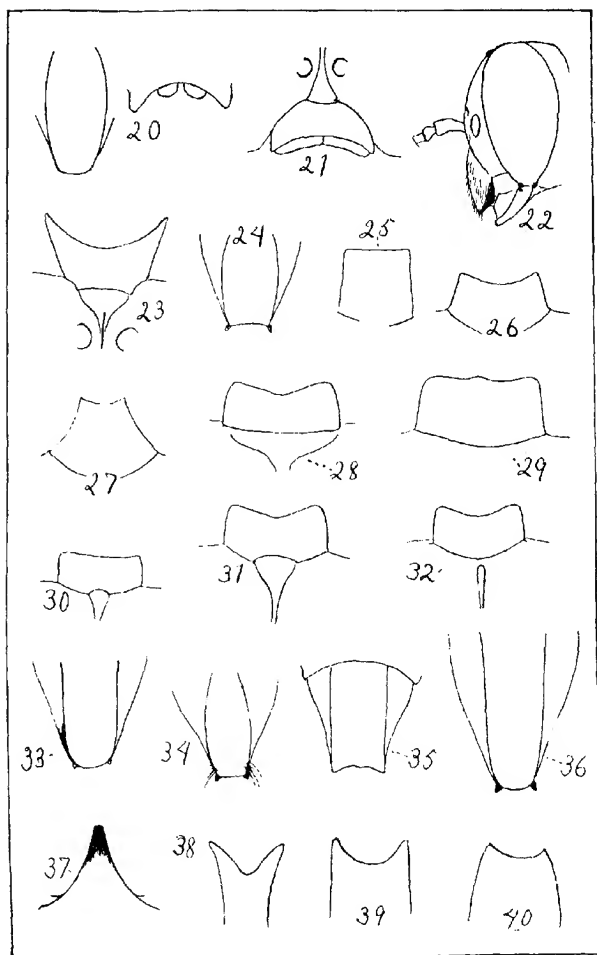
From Falls Church, Va., in August.

EXPLANATION OF PLATES.

- Fig. 1. *Cerceris psamathe*, head, clypeus in front.
Fig. 2. *Cerceris psamathe*, pygidial area of female.
Fig. 3. *Cerceris mandibularis*, clypeal process, front from above.
Fig. 4. *Cerceris clymene*, clypeal process, above.
Fig. 5. *Cerceris clypeata*, clypeal process above.
Fig. 6. *Cerceris ampla*, pygidial area of male.
Fig. 7. *Cerceris prominens*, clypeal process, above.
Fig. 8. *Cerceris chryssipe*, clypeal process, above.
Fig. 9. *Cerceris alaope*, clypeal process, above.
Fig. 10. *Cerceris finitima*, pygidial area, female.
Fig. 11. *Cerceris finitima*, clypeus in front, female.
Fig. 12. *Cerceris zelica*, clypeal process, front.
Fig. 13. *Cerceris bicornuta*, clypeal process, front.
Fig. 14. *Cerceris gnara*, clypeal process, above.
Fig. 15. *Cerceris blakei*, clypeal process, above.
Fig. 16. *Cerceris ampla*, clypeal process, above.
Fig. 17. *Cerceris compacta*, clypeal process, front.
Fig. 18. *Cerceris compar* clypeal process, front.
Fig. 19. *Cerceris nigrescens*, pygidial area, female.
Fig. 20. *Cerceris robertsoni*, female, pygidial area, and clypeal process in front.
Fig. 21. *Cerceris mandibularis*, clypeal process, front from below.
Fig. 22. *Cerceris kennicotti*, head, female.
Fig. 23. *Cerceris frontata*, clypeal process, above.
Fig. 24. *Cerceris compacta*, pygidial area, male.
Fig. 25. *Cerceris morata*, clypeal process, above.
Fig. 26. *Cerceris arclate*, clypeal process, above.
Fig. 27. *Cerceris irene*, clypeal process, above.
Fig. 28. *Cerceris halone*, clypeal process, above.
Fig. 29. *Cerceris deserta*, clypeal process, above.
Fig. 30. *Cerceris mandibularis*, clypeal process, above.
Fig. 31. *Cerceris fasciola*, clypeal process, above.
Fig. 32. *Cerceris nigrescens*, clypeal process, above.
Fig. 33. *Cerceris fasciola*, pygidial area, female.
Fig. 34. *Cerceris mandibularis*, pygidial area, female.
Fig. 35. *Cerceris fumipennis*, pygidial area, male.
Fig. 36. *Cerceris fulvipediculata*, pygidial area, female.
Fig. 37. *Cerceris firma*, clypeal process, above.
Fig. 38. *Cerceris clypeata*, male, last ventral segment.
Fig. 39. *Cerceris prominens*, male, last ventral segment.
Fig. 40. *Cerceris deserta*, male, last ventral segment.



Banks.



**NATURAL HISTORY AND GENERAL BEHAVIOR OF THE
EPHEMERIDAE NYMPHS HEPTAGENIA
INTERPUNCTATA (SAY).**

By J. E. WODSEDALEK.

There is a comparatively small amount of literature on the behavior of the Ephemeridæ. Probably the best general account is that given in Miall's "Natural History of Aquatic Insects." This treatise contains greatly abridged and reproduced in English, the useful account of the life history of the Ephemera found in Swammerdam's "Biblia Naturæ," and the very entertaining description of Reamur, but the behavior of these insects has been a subject of practically no experimental investigations. The species upon which the present study is based is *Heptagenia interpunctata* (Say), which is described in Needham's work on "May-Flies and Midges of New York."

HABITAT AND GENERAL HABITS.

Especially in the fall of the year these nymphs are found in ample abundance clinging to the under sides of rocks on the shores of Lake Mendota. Although they may be found under almost any rock, they are most numerous on greenish brown stones corresponding to the coloration of the nymphs, and presenting a rough surface well covered with small aquatic plants. This choice of habitat is probably determined, to a great extent at least, by their negative phototaxis and strong positive thigmotaxis, since I have never seen the nymphs on the upper or the lateral faces of stones.

In a previous paper* the reactions to light and their control by chemicals in *H. interpunctata* have been discussed in considerable detail. It was found that when the nymphs are placed in a long glass dish of water near a window they immediately swim away from the light. The same negative reaction takes place when the dish is taken into a dark room and a light is introduced near one end. It was also found that this strong negative phototaxis can be reversed by means of various chemical solutions.

*Wodsedalek, J. E. Phototactic Reactions and Their Reversal in the May-Fly Nymphs *Heptagenia Interpunctata* (Say). Biological Bulletin Volume 21, Pages 265-272, 1911.

The nymphs have a wonderful clinging power. Their flattened bodies, and limbs which extend laterally, are pressed close to the rock, thus enabling the insects to retain their hold and escape the full force of the waves. The legs are supported distally with sharp claws which the nymph digs into the small holes and crevices of the stone. While removing the insects from the stones one can often feel the resistance which they offer despite their small size, and in some cases they cling with such force that their stubbornness often results in the loss of a limb or two. This misfortune however does not seem to be disastrous to the vitality of the insect, and the lost appendages soon regenerate.

Although the nymphs spend most of their time lying quietly, it is astonishing to see with what rapidity they can move with their flattened bodies over the moist surface of stones when they are disturbed, even if the stones are inverted so that the insect is compelled to move with its dorsal surface downward. The latter fashion appears to be even less difficult, owing probably to the fact that they almost continually cling to the under side of rocks in their natural habitat. They frequently move sidewise and even backward, and are so active that an attempt to collect them from stones under water is an almost impossible task.

All summer these insects occupy a narrow strip, about three feet wide, along the lake shore and are particularly numerous on the shores of Picnic Point. Along in the latter part of October as the water turns cool, the nymphs slowly begin to migrate into deeper water and practically all desert the shallow water before the ice begins to form. A careful search was made on the day the ice broke up in the spring but not a single specimen was seen. A few days after the ice disappears, however, the nymphs begin to make their appearance.

I have never seen the nymphs swimming freely in their natural habitat, although when a stone to which several of them are attached is suddenly jerked out of the water, some become dislodged and quickly make for a neighboring rock. They swim in an undulating movement, bending the head, now up, now down, but this locomotion is by no means as rapid as when they are in contact with some object under water. Ordinarily the two lateral setæ are distended at an angle of about forty-five degrees, but during the swimming they are drawn in

toward the middle one, thus forming a sort of flexible paddle. When the swimming movements cease, the setæ are again distended, allowing the nymph to sink slowly to the bottom, or to take a short rest in suspension before another seemingly strenuous effort at swimming is resumed. Short distances of two or three inches are usually made with alacrity, but a longer distance seems to fatigue the nymph and little progress is made. However, when shelter is in evidence the movement increases, and almost invariably the nymphs put on extra speed on the home stretch.

May-Fly nymphs obtain their oxygen from the water by means of the seven pairs of tracheal gills which are attached to the first seven abdominal segments. The nymphs would be quite inconspicuous in their natural habitat were it not for the simultaneous backward and forward motion of the gills. While they are in a quiet attitude, all of the gills are not usually brought into play and their motion varies in proportion to the physical exertion, and to some extent at least, in proportion to the amount of food within the body of the nymph. The motion of the gills can be greatly increased by giving the nymph vigorous exercise and also by keeping it out of water for some time. Specimens destitute of nutrition for several days exercise their gills to a comparatively small degree.

FOOD AND FEEDING.

Ten active specimens were placed in separate dishes of water containing a bare rock, and after a few days of fasting, all chewed at a piece of alga when brought near to their mouth parts, as long as they were attached to a stone, finger, or some other object. It might be well to mention the fact that algæ form the greatest share of the food of these nymphs and that animal food is not taken until the nymphs are well starved, when they chew at almost anything they come in contact with. When the stones were removed, the nymphs refused to eat unless the piece of food was large enough to afford attachment. Some of the nymphs ate almost immediately after coming in contact with the food, while others did not do so until after several days. Others again would attach themselves to smaller pieces of alga, but would not eat unless the particle of food was lightly pressed against their mouth part. Evidently the particle of food was too small to afford comfortable attachment and the

soft consistency of the alga did not offer the proper contact stimulus.

There seems to be sufficient evidence that small objects are not seen by the nymphs, for very frequently they will repeatedly ignore a particle of food held in their immediate neighborhood. This is also true of much fatigued specimens which, during their slow search for food, devour the savory morsels only when they accidentally hit upon them.

In another experiment I took ten specimens and placed each in a small dish of water containing a carefully measured piece of food. Daily observations were made and the results obtained are tabulated below. The (—) sign indicates that the food remained untouched; the (+) sign is meant to show that part of the food had been eaten, and (O) marks the day when no food remained in the dish:

Specimen	Size of food	1	2	3	4	5	6	7	8	9	10	11	12
1	1 sq. mm.	—	—	—	—	—	—	—	—	(O)			
2	1.5 "	—	—	—	—	+	—	—	—	died			
3	2 "	—	—	—	—	—	—	—	—	—	(O)		
4	2.5 "	—	—	—	—	—	—	—	—	—	—	—	(O)
5	3 "	—	—	—	—	+	—	—	+	(O)			
6	3.5 "	—	—	+	—	+	+	(O)					
7	4 "	—	—	—	—	+	+	+	(O)				
8	4.5 "	—	—	+	+	?	+	(O)					
9	5 "	—	+	—	—	+	+	+	(O)				
10	5.5 "	+	+	+	+	+	?	(O)					

The experiment was repeated with another set of nymphs, and similar results were obtained. Evidently the specimens in the first few cases did not see the piece of food, and ate it only when they came in contact with it by chance.

THIGMOTAXIS.

The strong positive thigmotaxis of the nymphs, as was stated in speaking of their habitat, is apparently the most pronounced feature of their behavior. When several specimens

are placed in an aquarium they mass together into clusters where they remain for many hours, and if recently collected, even days. As soon as a rock or any other object is placed in the water, the loose forms swim toward it, while considerable time often elapses before the masses are broken up.

Two long bricks were placed one over the other in a basin of water and between them small pebbles varying in size so that the space gradually varied in thickness from one end to the other. Then a large number of nymphs were put in the water, and after a short time it was found that nearly all of the specimens were attached to the lower surface of the upper brick with their dorsal side downward, and a large majority of the specimens were in that portion of the wedge-shaped space where their backs came in contact with the brick below.

Then a stone to which several nymphs were attached, was placed in a tin pan and the temperature of the water was slowly raised. As the temperature approached 42°C. several specimens began to lose hold of the rock, others clung to it until the temperature reached 45°C. and in no case did the specimens desert the stone until they were completely overcome by the heat. Then a large stone was placed in the pan, half of it being above the surface of the water. On top of this were placed other rocks highly heated and thus heating the stone half submerged, to which the specimens were attached. A piece of ice was kept in the water to keep it cool, while the temperature of the rock was quite high. This time the insects did not hug the rock as tightly as is their natural custom, but clung to it in a sort of half fast fashion. That, however, was not the only sign manifesting discomfort, as upon close observation it was noticed that first one foot would be withdrawn from the hot rock and then another, the specimens clinging by four or five feet at a time and cooling the others. The space between the nymph and the rock would grow wider and wider until the insect would hang by only one or two claws and finally fall down backward to the bottom. As soon as refreshed in the cool water it would again attach itself to the hot rock. This same process was repeated over and over, though when long continued the rock was not sought with such extreme anxiety as in the beginning.

Although most of the nymphs behaved in that way, occasionally one would leave the rock when the temperature of the stone was about 40°C. and would not return for a long time.

When it was brought near the stone again, it would at first swim toward it, but as soon as the heat was felt it would again turn and swim away. Some of the forms, upon coming in contact with the hot rock, would suddenly dart off, make a little circuit, and then return. This was repeated several times, the circuit becoming more and more extended until finally the nymph would no longer return to the stone. Still others would leap from place to place on the rock as though in search of a cool spot, some finally deciding to leave the stone, while others would quietly settle down and like the large majority of them, would cling to the stone until overcome by the heat.

While working on the food reactions, I came across a specimen that showed an exceptionally strong thigmotactic propensity. When it was placed in a separate dish of water it swam about very much animated, and after intervals of rest, its vigorous activity was again resumed. When a stone was placed in the dish the nymph eagerly attached itself and remained perfectly quiet, but when the stone was taken out and a small piece of alga was placed in the dish, the insect would come up to it, attach itself, and then quickly swim away again. The soft consistency of the plant evidently did not appeal to it. The circus movements were repeated every time I appeared near the dish. Not until after five days of fasting did the nymph attach itself to the morsel of food, to which it clung so firmly that its body became a complete ring. Then it commenced to feed on the ball of food it held so tightly in its claws. The smaller the piece of alga became the more tightly the specimen seemed to cling to it. Finally when only a small part of the food was left, the nymph discontinued feeding but still clung to the small particle. Thinking that this was probably due to the chemical stimulus of the plant, I took it away and gave the nymph a tiny pebble about the size of an ordinary sweet pea. The pebble was eagerly accepted but being much too small to afford normal attachment, the nymph coiled itself around the pebble and thus brought as much of its body in contact with it as possible. It continued encircling the pebble for six days when I noticed that it was about to moult. This was a difficult task, and although the pebble was cast aside during the attempt to get out of the old skin, the specimen now retained its ringlike shape. As the nymph was unable to moult in that condition, the old integument was carefully torn off, but the unfortunate

specimen still remained helpless, disfigured, and unable to swim. All attempts to make it attach itself to a flat surface were of no avail, as the nymph would spring up like a stretched out hoop and fall to the bottom. When a small pebble was placed against the ventral surface of the insect, it was grasped and held tightly. Every day I gave it a trifle larger pebble and by the time of the next moulting, the nymph almost recovered its normal form.

Undoubtedly the specimen experienced some difficulty from the beginning, in clinging to so small a pebble in such an unnatural condition, and yet the content derived through the contact with the pebble must have been more potent, for the nymph would curl itself about the pebble, getting as much of its body in contact with it as possible, in spite of the fact that the body coiled itself into a complete ring.

DEATH FEIGNING INSTINCT.

The death feigning instinct is quite pronounced in May-fly nymphs when roughly handled out of water. It is rather difficult, however, to make them feign death in water and when one is successful the feint lasts but a few minutes at the most, usually only a few seconds.* Holmes found that mature *Ranatra*s will feign death very readily when taken out of the water and laid on the table, and that they will endure all sorts of maltreatment during the death-feint, even suffering their legs to be cut off one by one or their bodies cut in two without the least response. Most May-fly nymphs can be made to feign death by taking them out of the water and throwing them on the table, but the time of the feint varies widely in the different individuals, some feigning only a fraction of a minute, and others as long as fifteen minutes. The average death-feint lasts about two or three minutes, but it can be prolonged by stroking the nymph on the sternum or ventral part of the abdomen. Under such conditions some specimens were observed to feign death on a very damp piece of cloth for a period longer than an hour.

By placing nymphs with their backs against a rock, and the abdomen with the tracheal gills submerged under water, I have seen some of them feigning death as long as sixty-five minutes

*Holmes, S. J. Death Feigning in *Ranatra*. The Journal of Comparative Neurology and Psychology, Volume 16, No. 3, pages 200-216, 1906.

at a time, despite the fact that the anterior part of the body was exposed to the air. I sometimes came across forms that could not be made to feign death at all, in others again, though very rare cases, the feint would be so pronounced that pricking the insects only made them more rigid and apparently under obligation to serve their time in that attitude. Usually, however, a touch with a sharp object makes the nymphs discontinue the feint while a smooth object tends to prolong it. Sometimes, before the recovery from a death-feint, the nymphs begin to move the setæ, or stretch out a limb, and then a quick movement of the other limbs follows. Ordinarily, however, the recovery is a sudden jerk, and occasionally, if the nymph happens to lie ventral side downward, the violent, simultaneous extension of the folded legs throws the nymph into the air. Most nymphs can not be made to feign death longer than fifteen minutes on a dry table, a fact probably due to the disturbance in the metabolism of the body occasioned by the lack of oxygen.

MOULTING AND LIFE CYCLE.

The nymphs moult on the average once in about two weeks; the intervals being largely independent of the age and size of the insect. They grow on the average about one-third of a millimeter during the time which elapses between the two successive moults. They do, however, moult several times after they are apparently full grown, or when the growth in length at least, is not appreciable. The number of moults would probably vary during the different seasons if the nymphs were in their natural out-of-door environment and the almost regular moulting may be possibly influenced by the almost invariable temperature of the water in the aquaria.

Ten individuals varying from one to nine millimeters, were kept in separate dishes with an abundant supply of food; daily observations made, and the dates of the various moults recorded which are given in the following table. Several of the larger forms metamorphosed and some of the small ones died within a month or two, and these I was unable to replace on account of the rare sizes, but two lived as long as the experiment was continued.

I	II	III	IV	V	VI	VII	VIII	IX	X
1 mm.	1.5 mm.	2.5 mm.	3 mm.	4 mm.	5 mm.	6 mm.	7 mm.	8 mm.	9 mm.
Nov. 7	Nov. 8	Nov. 7	Nov. 9	Nov. 8	Nov. 10	Nov. 6	Nov. 8	Nov. 9	Nov. 10
Nov. 22	Nov. 20	Nov. 20	Nov. 22	Nov. 20	Nov. 21	Nov. 18	Nov. 18	Nov. 20	Nov. 20
Dec. 3	Dec. 1	Dec. 1	Dec. 4	Dec. 1	Nov. 30	Nov. 30	Nov. 30	Nov. 30	Dec. 1
Dec. 19	Dec. 13	Dec. 13	Dec. 15	Dec. 12	Dec. 9	Dec. 8	Dec. 7	Dec. 9	Dec. 12
	Dec. 28	Dec. 23	Dec. 23	Dec. 22	Dec. 22	Dec. 21	Dec. 18	Dec. 19	Dec. 30
	Jan. 13	Jan. 5	Jan. 8	Jan. 4	Jan. 5	Jan. 5	Jan. 4	Jan. 6	Jan. 8
		Jan. 23	Jan. 22	Jan. 15	Jan. 16	Jan. 26	Jan. 20	Jan. 18	Jan. 16
			Feb. 10	Jan. 29	Feb. 2	Feb. 10	Feb. 6		
			Feb. 24	Feb. 12	Feb. 16	Feb. 23		Metamorphosed	Metamorphosed
			Mar. 5	Feb. 26	Feb. 28		Metamorphosed		
			Mar. 21	Mar. 4	Mar. 12				
			April 3	Mar. 28					
			April 18	April 13					
			May 4	April 29					
			May 19	May 16					
			June 2	May 30					
			June 17	June 16					

Just how long *H. interpunctata* live I am not entirely certain, as I have been unable to keep any specimens throughout their whole life history. However, there seems to be sufficient evidence that their life extends through a period of two years. In the observation on moulting careful measurements were made of all the specimens after each successive moult. From these data the entire life cycle can be inferred. For example, specimen I which was one mm. long November 7, was one and one-half mm. long December 3; specimen II, one and one-half mm. long November 8, was two and one-half mm. long December 13; specimen III, two and one-half mm. long November 7, was three mm. long January 23; specimen IV, November 9, was three mm. long, or the same length as specimen III had attained when its record ceased, was seven mm. long in June.

Specimen VIII which was seven mm. long in November 8, metamorphosed three months later.

Specimen I, which was one of the smallest obtained in November, was apparently an offspring of the last adults of the season, which metamorphosed in the latter part of August. On further plausible supposition, that it hatched the first part of September, specimen I was about three months old on December third, when it was one and one-half mm. long. Adding to this the time it required specimen II to become two and one-half mm. long, and specimen III to attain three mm. and so on, we have a total of nineteen months, an apparent gain of five months. This gain, however, is easily accounted for owing to the fact that the specimens had the advantage of wintering over in the aquaria. Such a gain actually took place in the larger specimens, which metamorphosed in January, February, and March, and no doubt would not have metamorphosed until June, July, or August of the following summer had they remained in their natural habitat.

The members of this species do not all emerge in the same day or few days, as is true in many other Ephemeridæ, but adult specimens may be collected near Lake Mendota any time from the latter part of June to the latter part of August. The emergings are most numerous in the afternoon. The nymphs crawl up on the rocks, a split appears in the median line of the mesothorax which quickly extends through the pro and metathorax. The head appears first and then the thorax, closely followed by the first pair of legs. A few jerks cause the extrication of the wings and a moment later they become erect. The other two pairs of legs are pulled out about the same time and soon the entire subimago is exposed. After a short rest the insect flutters upward and usually settles a short distance away. This whole process is completed within five or six minutes. On several occasions, when the lake was quiet, I observed the entire emerging process take place at the surface of the water. The sub-imago skin is usually shed within a few hours after the emergence, and the entire life of the adult is comparatively short, lasting about six days at the most and many of the specimens live a much shorter time.

I wish to express my thanks to Prof. S. J. Holmes for his suggestions and kind criticisms.

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NEW WESTERN TIPULA.

By R. W. DOANE, Stanford University.

Kertész's "Catalogue Dipteorum" vol. II ("conclusum exitu anni 1900") lists 309 species belonging to the genus *TIPULA*. In 1901 I published descriptions of 52 additional species. Between that time and this there have appeared in various journals descriptions of some 16 other species, 7 of which are American. This makes a total of 377 species described before the beginning of 1911.

All who have worked with the genus know that long ago it became unweildy and realize that it should be divided into a number of smaller genera. But no one has yet been able to separate the genus into groups well enough defined to be worthy of generic or even subgeneric rank. My studies have convinced me that any satisfactory division of the group must be founded on a study of the structure of the hypopygium. This will mean that all the types that are available will have to be re-examined, for few if any of the earlier descriptions describe this organ in any detail, even the late descriptions refer only briefly to the more conspicuous parts and pass the others over entirely. That the structure of these often remarkably complicated organs is the final test for the determination of species has been demonstrated time and again when two or more forms, exactly alike in all other respects, have been found to exhibit constant striking differences in the structure of the hypopygium.

Hesitating to add still more species to the genus until some such a division is made, I have refrained from publishing descriptions of new species, having during the last ten years described only a few forms that were, on one account or another, of particular interest. I find now that I have in our collections here many undescribed species some of which I have been sending out to my correspondents with manuscript names. In order that these names may be legitimate and that I may more easily keep our large collection of *Tipulidæ* in better shape, I have decided to publish descriptions of a few of the undescribed species that I now have before me, confining myself, in this paper, to western forms.

***Tipula acutipleura* n. sp.**

Light brown; head grayish brown, with a brown line above; rostrum yellowish with a brown stripe laterally; palpi brown; first and second segment of antennæ yellow; third segment fusiform, yellowish, darker in the middle, remaining segments growing darker, those beyond the fifth wholly brown, each darker and somewhat incrassated at the base; collare lighter brown with three brown spots; mesonotum very light brown with four rather broad brown stripes; coxæ, pleura, scutellum and metanotum hoary, the latter with three narrow stripes which are less hoary; halteres yellow, knobs brown; legs yellowish, tarsi and the tips of the femora and tibia brown; abdomen light brown with a rather broad brown line above; eighth sternite narrowed posteriorly, posterior margin with a shallow rounded incision from the sides of which arise tufts of rather long, stiff, curved, yellow hairs; ninth tergite small with a deep V-shaped incision and a narrow median depression; ninth sternite almost divided by a deep broad U-shaped incision in which hangs a pair of yellow tumid appendages; pleural suture almost completely setting off the somewhat triangular pleura which are produced posteriorly into a rather long acute black-tipped process; upper pair of appendages spatulate, tips with long black hairs, lower pair broad, flattened, yellow, distal margin black, more strongly chitinized and somewhat twisted; wings hyaline with a slight grayish tinge; an indistinct whitish band beginning in front of the stigma and extending into the base of the fourth and fifth posterior cells; another indistinct whitish spot in the middle of the first and the bases of the second and third posterior cells; stigma and a small spot over the tip of the auxilliary vein brown; discal cell more than three times as long as wide; Length 11 mm., wing 12 mm.

Habitat: San Diego, Cal. 1 male.

***Tipula atrisumma* n. sp.**

Male: brownish yellow; head grayish brown with a darker brown line above; rostrum yellowish, somewhat grayish above; palpi wholly brown; first and second segments of antennæ yellow, others wholly brown, those beyond the fourth slightly incrassate at the base; collare brownish with two yellow spots; mesonotum yellowish, with three broad brown stripes the median one divided by a faint gray line; coxæ pleura and metanotum hoary; scutellum brownish yellow; halteres brownish, knobs darker; legs brownish yellow, tarsi and tips of femora and tibia darker; abdomen yellowish with a very broad brown line above, posterior margin of segments yellow; posterior margin of eighth sternite with a median pair of short yellow projections which are but little longer than wide; median one-third of ninth tergite yellow, rest brown, with a broad deep incision and a median depression; just below the median portion of the groove is a pair of short, black, highly chitinized, triangular plates; ninth sternite with a deep very broad U-shaped incision from the lateral margins of which hangs a pair of short slightly tumid processes; pleural sutures complete; pleura produced into a

rather long somewhat curved process the black tip of which ends in two short points; first pair of appendages spatulate, second pair broad, flattened, twisted and ending in two short black tips the upper one of which is longer, broader and triangular; wings hyaline; stigma brown; the indistinct whitish line not reaching the base of the fourth posterior cell.

Female: First and second joint of antennae yellow, third and sometimes the fourth somewhat yellowish, others brown; eighth tergite a little shorter than the seventh, eighth sternite about as long as the seventh; posterior margin with a crescent-shaped incision and depressions: the apical appendages, corresponding to the lower valves of the ovipositor, are short, quadrate, upper margins more strongly chitinized with the edge twisted or rolled, posterior margins with sharp-pointed triangular processes ninth tergite about half as long as eighth; tenth tergite narrow, about twice as long as ninth ending posteriorly in a pair of short, round-tipped lobes, beneath which is a broad, short, unchitinized appendage which also ends in a pair of short lobes similar to those above; ninth sternite, lying above the eighth sternite, consists of two strongly chitinized lateral plates which are united posteriorly into a rather long sharp process. Length, male 9 mm.; female 11 mm., wing 10 mm.

Habitat: San Diego, Cal. 11 ♂, 5 ♀.

Tipula incurva n. sp.

Brown; head grayish brown; rostrum yellowish brown; palpi brown; first, second and third joints of antennae yellow, others brown, cylindrical, slightly darker at base; collare grayish brown with four brown spots; mesothorax grayish brown with four brown stripes, the median ones indistinctly divided by grayish lines; coxae and pleura hoary; scutellum and metathorax yellowish; halteres yellow, knobs brown; femora yellow; tarsi, tibia and tip of femora brown; abdomen yellowish brown with the anterior margin of each segment darker brown; ninth tergite brown, short, broad, with an inconspicuous median ridge, posterior margin with a slight crescent-shaped incision; posterior lateral angles ending in short, blunt, downward-projecting processes; ninth sternite with a broad rounded incision from the posterior lateral angles of which arises a pair of two-lobed inward and upward projecting appendages, the lower lobe being much the smaller of the two; second pair of pleural appendages almost concealed by the first which are rather broad, flattened and bluntly pointed at the tip; wings with a brownish tinge; a rather broad, whitish band beginning in front of the stigma and extending through the basal cells a short distance from their tips to the sixth vein, along which it extends to the posterior margin of the wing; an irregular whitish spot about the middle of the axillary cell; another covering the basal two-thirds of the discal cell, and another in the base of the second marginal and sub-marginal cell; stigma brown; discal cell twice as long as wide. Length 10 mm., wing 11 mm.

Habitat: Nebraska. 1 male.

***Tipula alta* n. sp.**

Brown; head brown; rostrum yellow; palpi yellow darker toward the tips; first and second joints of antennae yellow, others brown, segments rather long, cylindrical; collare light brown with three darker brown spots; mesothorax grayish brown with three brown stripes, the median one divided by a grayish line; pleura hoary; scutellum and metathorax yellowish the latter somewhat hoary; halteres brown, knobs darker brown; legs yellowish tarsi and tips of femora and tibia brownish; abdomen brownish yellow, with a broad dorsal line and interrupted lateral brownish bands; posterior margin of eighth sternite with a crescent-shaped incision from the posterior margin of which arise two tufts of rather long yellow hairs; ninth tergite with a broad, deep V-shaped incision the margins of which are black; ninth sternite yellow, with a broad, deep depression; pleural suture very short; pleura yellow, somewhat triangular, first pair of appendages small, spatulate, second pair broad, flat, the lower branch somewhat hooked-shaped and black-tipped; wings hyaline; stigma brown; an indistinct interrupted whitish band beginning in front of the stigma and extending into the base of fourth posterior cell; discal cell in the single specimen before me open. Length 9 mm., wing 9 mm.

Habitat: Lander, Wyoming. 1 male. Alt. 5,000 to 8,000 feet.

This is the first *Tipula* I have seen with an open discal cell. As I have only a single specimen before me I do not know whether this is a constant character or only accidental.

***Tipula marina* n. sp.**

Brown; head grayish brown; rostrum grayish brown; palpi dark brown; antennae wholly dark brown; segments beyond the third somewhat excised below; collare grayish brown; mesonotum light brownish with three broad, dark brown stripes, each of which is divided by a light brown line; coxae, pleura, scutellum and metanotum grayish, somewhat hoary; halteres brownish, knobs darker; legs brownish, base of femora and tibia somewhat yellowish; abdomen brown, posterior margins of segments narrowly, lateral margins, broadly lighter; ninth tergite reddish brown, darker toward the base, posterior lateral angles somewhat produced, tips rounded; with a median deep, narrow V-shaped incision; no pleural suture; third pair of appendages short, tumid, brownish yellow, covered with short yellow hair; wings with a brownish tinge much lighter toward the base; the rather broad whitish space bordering the fourth vein extends through the discal cell and the fourth posterior cell to the posterior margin of the wing, in the region of the præfurca it widens and extends to the anterior margin and sends a broad irregular shaped arm through the second basal cell; bases of the marginal, sub-marginal and first posterior cells whitish; veins and stigma brown. Length male 13 mm., wing 13 mm.

Habitat: Palo Alto, Cal. 3 males.

Differs from *T. tristis* Doane, which it somewhat resembles in being larger, darker, wings darker and in the V-shaped incision on the posterior margin of the ninth tergite being broader posteriorly, narrower anteriorly and much deeper.

***Tipula fulvinodus* n. sp.**

Brown; head brownish, cinereous above with a median broad, brown stripe; rostrum yellowish on the sides; palpi brown; first and second segment of antennae yellowish; third brownish yellow, others light brown; dorsum of thorax very light brown with three broad, brown stripes each of which is divided by a gray line; scutellum, metanotum and pleura grayish pruinose; halteres light brown, base yellow, knobs darker brown; legs yellowish, tips of femora, tibia and tarsi darker; abdomen brown, darker posteriorly with three darker brown stripes, posterior margin of each segment yellowish; posterior margin of eighth sternite with a rather deep incision, posterior lateral angles each having a tuft of long yellow hair; posterior margin of ninth tergite with a Y-shaped incision, lateral angles rounded, yellow; ninth sternite with a broad rounded incision in which hangs a pair of whitish appendages the tips of which are brown, flattened and covered with thick, short yellow hair; pleural suture very indistinct, pleura whitish; first pair of appendages whitish, long, very slender, slightly curved; second pair broad, flattened, tips with two black teeth; third pair long, narrow, slightly wider toward the tips; wings hyaline; stigma brown; a whitish spot just beyond the stigma and a faint broken, hardly perceptible whitish band beginning in front of the stigma and extending through the discal cell into the base of the fourth posterior cell. Length 12 mm., wing 13 mm.

Habitat: Grand Coulee, Wash. 1 male.

***Tipula nigrocorporis* n. sp.**

Head and thorax blue-black; palpi dark brown, reddish brown toward the tips; antennae dark brown, second segment yellowish; joints of flagellum deeply incised, dorsum of thorax with three rather indistinct brown lines; femora yellow, tips brown; tibia and tarsi brown; halteres yellowish, knobs brown; first segment of abdomen black, others brownish yellow with a brown, lateral stripe, the sixth, seventh and eighth quite brown, yellowish posteriorly; ninth tergite with a broad, deep, crescent-shaped incision; ninth sternite with a deep V-shaped incision which almost separates the two sides of the segment; pleural plates distinctly separated from the lateral parts of the sternum; wings light brownish with four indistinct whitish spots, one before and one just behind the stigma, a larger one in the middle of the second basal cell and a fainter one in the middle of the anal and axillary cells. Length male 16 mm., wing 18 mm.

Habitat: Estes Park, Colo. 1 male.

***Tipula cylindrata* n. sp.**

Brown; head very dark brown; rostrum dark brown above, yellowish below; palpi blackish brown; first and second segments of antennae yellow, third brownish yellow, others dark brown, incised below; collare grayish with three brown spots; metanotum grayish with three brown stripes, each of which is divided by a broad gray line; coxae, pleura, scutellum and metanotum hoary; scutellum and metanotum with a median brown line; halteres yellow, knobs brown; legs brown, femora somewhat lighter toward the base; abdomen light brown, with a dorsal darker brown line; ninth tergite with a broad deep V-shaped incision, the lateral margins of which are notched; ninth sternite with a narrow very deep incision; the margins of which are continuous for a part of their length; no pleural sutures; pleural margin with a small triangular chitinated projection just outside the base of the short tumid brown third pair of appendages; wings with a grayish tinge, with several irregular more or less distinct whitish spaces; a rather broad, not well-defined whitish band beginning in front of the stigma, covering the distal portion of the first basal cell, crossing the second basal cell a little beyond its middle, and extending along the anal cell to the posterior margin of the wing; indistinct whitish spots in the base of the anal and axillary cells, in the tip of the sub-marginal cell, and in the base of the marginal, sub-marginal, first posterior, discal and fourth posterior cells; stigma and a small spot over the tip of the axillary vein and another over the tip of the praefurca, brown. Length 11 mm., wing 13 mm.

Habitat: San Diego, Cal. 3 males.

***Tipula flavomarginata* n. sp.**

Yellow; head cinereous above with a median brown stripe; rostrum, palpi and first two segments of antennae yellow; third segment yellowish, brownish toward the tip, other segments brown somewhat darker at the base; dorsum of thorax light yellowish with four distinct brown stripes; scutellum and metanotum yellow, with a faint, median, brown line; pleura yellow; halteres yellow toward the base, darker towards the knobs which are dark brown, tips lighter; femora, except the tip, yellowish; tibia and tarsi and the tips of the femora brown; abdomen yellowish at the base, brownish posteriorly, posterior margin of each segment yellow; eighth sternite slightly produced, posterior margin roundly emarginate with two bunches of reddish yellow hairs; ninth tergite produced and narrowed posteriorly, posterior margin with a crescent-shaped incision in the middle of which is a pair of short, black triangular, downward-projecting teeth, the ventral margins of the posterior lateral angles with narrow, elongate, black projections; ninth sternite divided ventrally by a broad membranous area, posterior margin with two pairs of small appendages, the upper pair ovate, tips with long yellow hairs, the lower pair more spatulate, hanging in the crescent-shaped incision in the posterior margin of the sternite; pleural suture distinct; upper pair of appendages narrow toward the base and broader toward the tip the anterior upper corner produced into a finger-

like projection; second pair of appendages broad, irregular in shape anterior margin folded back; third pair broad at the base, slightly narrower toward the tip, anterior upper corner produced into a broad, blunt tip; wings hyaline; the stigma, a small spot over the origin of the prefurca, and a narrow border along the great cross vein and the end of the fifth vein, brown; the whitish band beginning in front of the stigma extends across the discal cell into the fourth posterior cell, (in some specimens reaching almost or quite to the posterior margin); small white spot just beyond the stigma. Length 11 mm., wing 13 mm.

Habitat: San Diego, Cal. 8 males.

Tipula rusticola n. sp.

Yellow; head yellowish, darker above; palpi brown, last segment darker; first and second segments of antennae yellow, others light brown darker at the base; thorax light yellow, the brownish stripes of the dorsum faintly indicated; halteres yellowish, knobs brown, tips lighter; femora yellowish, tips brown; tibia and tarsus brownish; abdomen yellowish, brownish posteriorly; posterior margin of eighth sternite with two tufts of rather long, reddish yellow, hairs; ninth tergite with a broad, median furrow, lateral angles but slightly produced; ninth sternite divided by a rather broad, whitish membranous portion; from the posterior margin just at the edge of the membrane there arises a pair of chitimized two-parted appendages, the outer posterior part is somewhat spatulate the tip furnished with a fringe of reddish yellow hair, the inner part is broader, longer, somewhat twisted and with a double-pointed tip; first pair of appendages long, slender; second pair broad, black-tipped with three more strongly chitimized ridges; the third appendages are much smaller, unchitimized and have a small soft leaf-like lobe extending outwardly at right angles to the rest of the lobe; wings hyaline, veins brownish yellow; stigma brown; a whitish broken band beginning in front of the stigma and extending across the discal cell into the base of the fourth posterior cell. Length 12 mm., wing 12 mm.

Habitat: Keyport, Wash. 2 males.

Tipula derbyi n. sp.

Yellow; head dark brown pruinose above; rostrum brownish yellow; palpi very dark brown; first, second and basal half of third segment of antennae, yellow, other segments very dark brown; thorax yellow the three dorsal brown stripes more or less distinctly indicated; halteres brown, yellow at the base, knobs darker; legs yellow, tarsi and the distal portion of the tibia brownish; abdomen yellow somewhat darker posteriorly; dorsal and lateral lines more or less faintly indicated; eighth tergite of male semicircular; eighth sternite produced posteriorly and forming a floor for the genital chamber, posterior margin with a shallow semicircular incision which is filled with a white more or less tumid membrane; posterior lateral angles with sub-triangular chitimized processes, the terminal portion of which bear a few short, curved bristles; ninth tergite divided by a median suture into two sub-rectangular.

somewhat tumid, protruding processes the posterior lateral margins of which are sharply incised; ninth sternite large, lower posterior angles with somewhat curved, downward-projecting spatulate appendages, these are attached by the lateral margin and bear numerous short, reddish brown hairs near the tip; pleural sutures well-developed completely setting off the sharp-pointed triangular pleura, first pair of pleural appendages small, spatulate, second pair with a narrow stalk bearing a large, thin, irregular, rectangular plate; third pair somewhat spatulate, very much larger than the first pair, with rather long reddish hair at the tip; eighth sternite of female rather strongly chitinized, posterior lateral angles produced into short rounded lobes a little longer than wide; two short, broad, two-pointed strongly chitinized appendages arise from the posterior lateral angles of the broad truncate median lobe; ninth tergite very small almost concealed beneath the eighth; tenth tergite also very short, more strongly chitinized, cerci very short, broad, rounded; wings hyaline with a very slight smoky tinge, costal and subcostal cells yellowish; stigma brown, an interrupted whitish band running from in front of the stigma through the discal cell into the base of the fourth posterior cell, another whitish spot behind the stigma, a small indistinct brownish spot at the origin of the praefurca. Length male 13 mm., female 12 mm., wing 12 mm.

Habitat: Stanford University. Many males, 6 females.
Larvæ feeding on grain roots in meadows.

***Tipula pacifica* n. sp.**

Brown; head grayish brown with dorso-median and post-ocular broad, brown lines; rostrum grayish brown, sides darker; first and last segments of palpi dark brown, others lighter brown; first and second segments of antennæ yellowish brown others brownish, darker at the base; antennæ of female more yellowish; thoracic dorsum with very broad, brown stripes which are distinctly bordered by darker brown lines; median stripe divided by a fusiform brown line; lateral margins clouded with brown; dorso-pleural membrane whitish; pleura grayish brown with indistinct brown spots; an irregular brownish line just below the dorso-pleural suture; scutellum almost wholly brown; metanotum grayish with three broad, brown stripes; halteres brownish, knobs darker, tips whitish; legs brownish, tarsi and tips of femora and tibia darker; abdomen brown, darker brown laterally; extreme margins whitish, seventh, eighth and ninth segments almost wholly dark brown; posterior margin of eighth sternite yellowish, not produced posteriorly; posterior margin of ninth tergite yellowish, under surface with two black, triangular, downward-projecting processes; posterior margin of ninth sternite with a broad, deep rectangular incision; pleural suture indistinct, lateral margins with a pair of very large whitish irregular-shaped appendages some of the inner and upper folds of which are furnished with thick, short, black hairs or bristles; upper appendages rather broad, lateral margins somewhat rolled, tip rounded; ovipositor of female reddish brown, upper valves rather long, acute; lower valves

reaching about to middle of upper valves; wings long and broad, brown, with whitish spots in all the cells, a spot in the beginning of the basal cells, the origin of the praefurca, the stigma, the tip of the seventh vein and less distinct spots near the middle of the second basal, anal and axillary cells, darker brown; the margin of the wing is marked with larger or smaller whitish spots in all the cells; irregular whitish spots in the region of the stigma, the discal cell and in the basal anal cells; veins brown, some of them with a narrow brown border. Length male 26 mm., female 33 mm., wing 27 mm.

Habitat: Deer Park, Placer Co., Cal. 3 males, 2 females. (Types). Keyport, Wash. 1 female.

One of the males is much smaller measuring only 20 mm. wing 20 mm. In size and general appearance, this specimen looks somewhat like *T. abdominalis* Say, but the antennae, the markings on the thorax and the structure of the hypopygium are quite different.

Tipula californica n. sp.

Brownish yellow; head yellowish slightly darker above; palpi brown, yellowish toward the base; first and second and the basal half of the third segments of the antennae yellow, other segments brown, darker at the base; dorsum of thorax light brownish yellow with four broad, brown stripes; scutellum and metanotum brownish yellow; pleura hoary; halteres whitish, knobs brown, tips lighter; legs yellowish, tips of the femora, tibia and tarsi darker; abdomen yellowish, brownish posteriorly, sides with a distinct broken brown line; posterior margin of eighth sternite with a rounded incision, the middle with a short rounded projection above which arises two slender pencils of yellow hairs; lateral angles with a pair of triangular tooth-like projections which bear a fringe of long yellow hairs on their inner margins; ninth tergite with a deep median furrow and a rather deep V-shaped incision from the apex of which arises a short, triangular black-tipped tooth; ninth sternite with a very broad, deep U-shaped incision in which hangs a pair of large, tumid, yellow-haired appendages; apex of this incision with fine short, reddish-yellow hairs which almost conceal two short, conical projections; pleural sutures complete; first pair of appendages somewhat conical, furnished with rather long, black hairs; second pair broad, somewhat flattened edges black; third pair more strongly elongated, oblong, somewhat twisted, ending in a blunt point; wings hyaline with a slight brownish tinge particularly in the apex; the stigma and a small spot over the tip of the subcostal vein and the beginning of the praefurca, brown; veins with an indistinct whitish border; a whitish spot just before and just behind the stigma. Length 16 mm., wing 20 mm.

Habitat: Palo Alto, Cal. 2 males.

Tipula rupicola n. sp.

Brown; head brownish with broad, darker, dorso-median and post-ocular lines; rostrum darker brown; palpi very dark brown; antennae yellowish darker toward the tip, base of each segment beyond the third blackish; mesonotum tawny the three brown stripes bordered by distinct darker brown lines, the median one divided by a rather broad, dark brown line; dorso-pleural membrane whitish; pleura grayish brown; an irregular line just below the dorso-pleural suture, and other spots, darker brown; scutellum and metanotum brown; halteres light yellow, knobs brown, tips lighter; legs yellowish brown, tarsi and tips of femora and tibia darker, a broad whitish ring on the femora a short distance from the tip; abdomen brown, darker posteriorly, lateral margin darker; ninth tergite somewhat tumid, posterior margin reflexed and with a pair of inconspicuous black edged teeth, pleural suture complete extending to the anterior margin of the segment thus distinctly separating the pleura from the sternum; ninth sternite almost hidden by the eighth sternite; posterior margin with two broad appendages the edges of which are rolled in such a way that the contiguous edges of the two form a large projecting open tube; posterior margin of the pleura rather strongly chitinized, lower corner produced into a short, sharp point; upper pair of appendages broad, short, tips with a shallow rounded incision and with a fringe of black hairs; upper and posterior margin of second pair of appendages furnished with rather long reddish brown hairs the lower angle produced into a rather long spatulate projection; the upper posterior angle of the third pair of appendages strongly chitinized and bearing a few black hairs; wings rather broad and long, brownish with the following parts darker brown: the stigma, a spot over the origin of the prefurca, the base of the fourth posterior cell, the tips of all the veins beyond the apex of the wing, the middle of the posterior margin of the second basal cell, the middle of the anal cell; the distal portion of the second and fifth vein narrowly bordered with brown; a whitish spot beginning in the margin of the wing just beyond the stigma extends into the first posterior cell and follows it to the tip of the wing; another whitish spot beginning in the margin in front of the origin of the prefurca extends diagonally across the first basal and just into the second basal cell; other smaller spots in the discal, anal, axillary and the margins of all the posterior cells, those in the anal cell extending forward into the second basal cell. Length 25 mm., wing 25 mm.

Habitat: Oak Creek Canon, Ariz. 4 male.

The coloring of the body and the wing markings somewhat resemble *T. contaminata* Doane, but there are several differences the most important of which is the structure of the hypopygium. This and the following species, *T. albimacula*, have the pleural sutures well developed thus entirely separating the pleura from the other sclerites. Following Snodgrass, these species

would be in a group lower than any he studied, a group corresponding to the simplest of the brevipalpi where the pleura and sterna are entirely separated.

***Tipula albimacula* n. sp.**

Brownish yellow; head brownish yellow with a darker stripe above, first segment of palpi yellowish others brownish, last segment darker; antennae yellowish toward the base, growing darker toward the tip, last four or five segments brown; metanotum brown with three broad, darker brown stripes; pleura yellowish, pruinose, with a rather broad, brown stripe extending from above the base of the first coxae to the base of the wings; scutellum brown with a median lighter line; metanotum yellowish with a very narrow median brown line; legs yellowish, tarsi and tips of femora and tibia darker; abdomen yellowish, spotted with brownish, with dorsal and lateral brown stripes; first, sixth, seventh and eighth terga brownish; ninth tergite tumid, posterior margin with a broad crescent-shaped incision in the middle of which is a small semi-circular incision; ninth sternite similar to the preceding sternites, posterior margin bearing a pair of leaf-like appendages which are attached near the middle of their long sides, the margins of the opposing faces slightly curled in, thus forming an incomplete tube; pleural suture extending to the anterior margin of the segment, so that the pleural sclerites are completely separated from the others; upper appendages broad, rounded, margins somewhat more chitimized; lower appendages long, rather broad, somewhat twisted, ending in an upper rather broad, blunt arm and a lower narrow, curved, sharp-pointed claw; wings with a brownish tinge with several lighter and darker spots; an irregular broken V-shaped, whitish band beginning in front of the stigma and ending close to the tip of the sixth vein; a rather large irregular whitish spot on the margin of the axillary cell and other smaller whitish spots in all of the cells in the apical portion of the wing; the whitish spots in the margins of the posterior cells are bordered on each side by brownish spots. Length 20 mm., wing 22 mm.

Habitat: Arizona. 1 male.

See the note in regard to the hypopygium of *T. rupicola*.

***Tipula aspersa* n. sp.**

Brown; head grayish brown with a narrow median, dark brown line above and brownish lines back of the eyes; rostrum grayish brown, darker laterally; palpi dark brown; antennae yellowish, base of each segment beyond the third black; metanotum grayish with three brownish stripes each of which is margined by darker brown; median stripes divided by a narrow brown line, lower margin of metanotum bordered by a brown line; pleura grayish pruinose with two median brown spots and a brown stripe which begins on the prothorax and ends just beyond the mesopleural suture; scutellum and metanotum grayish, each with a median brown line; a brown spot above the base of the halteres; halteres yellowish, knobs brown; legs yellowish, tarsi and tips of femora

and tibia darker; abdomen brown with darker stripes dorsally and laterally; posterior margin of ninth tergite of male with a pair of shiny, brown, triangular projections between which is a deep narrow U-shaped incision; ninth sternite completely bordered below by a deep V-shaped incision; pleural suture distinct curving upward about the middle of the segment after which it soon disappears; upper appendages long, broad, strap-like, tips rounded; lower appendages broad, the chitinized margins rolled upon themselves, the distal margin with a long, strong claw; upper valves of ovipositor of female long narrow tips rounded; lower valves rather broad, flat, tips acute; wings with a brownish tinge with brown spots at the tips of all the veins, on the origin of the praefurca, and in the second basal and anal cells; third vein and anterior branch of the fourth vein with brownish spots near the middle; second, third and fourth posterior cells with brownish spots toward the bases; stigma brown; an interrupted whitish band beginning back of the stigma and extending across the discal cell into the base of the fourth posterior cell. Length male 14 mm., female 19 mm., wing 17 mm.

Habitat: Pacific Grove, Cal. 1 male, 1 female.

Tipula planicornia n. sp.

Brownish yellow; head yellowish somewhat cinereous above, with a median darker line; palpi yellow, last segment brown; first three segments of antennae yellow, fourth sometimes also yellowish, others brown, darker at the base; dorsum of the thorax brownish yellow, with three brown stripes the median one divided by a cinereous or yellowish line; scutellum yellow with a median, brown line; pleura and metanotum grayish pruinose; halteres yellow, knobs brown, tips lighter; legs yellow, tarsi somewhat darker; abdomen brownish yellow, darker posteriorly, the median, dorsal, brown line broader than the later lines; posterior margin of the eighth sternite with a shallow rounded incision, middle portion with a whitish membrane from which arises two brush-like tufts of long, light yellow hairs, as both tufts are directed inward they cross each other; lateral angles furnished with a broad, irregular-shaped chitinized appendage, the upper inner angle of which is drawn out into a rather long, flattened, slightly curved claw; the inner anterior face of this appendage is furnished with two ridges or keels, the upper one has a serrate, hairy margin, the lower one, running at right angles to the other, is produced into a long, narrow, slightly curved arm; ninth tergite small, posterior margin with two small crescent-shaped incisions between which is a sharp, triangular, furrowed tooth; ninth sternite with a very deep U-shaped incision which is filled with a pair of appendages the posterior faces of which are chitinized and each terminating in a pair of backward-projecting claws, the lower ones long and curved, the upper ones short, less strongly chitinized, inconspicuous; pleural suture complete; upper pair of appendages reddish brown, broadly spatulate, furnished with long, brownish and yellowish hairs; second pair elongate, suddenly broadened about the middle, posterior margin with long yellow hairs, distal margin black, strongly chitinized, third pair yellow, narrowly spatulate; the long, strongly chitinized,

black-tipped, shield-shaped penis guard often shows distinctly between these appendages; abdomen of female long, cylindrical; ovipositor reddish brown, upper valves long, slender, acute, lower valves broader, less acute; wings hyaline with a slight brownish tinge; stigma light brown, inconspicuous; a rather distinct whitish band beginning in front of the stigma and extending through the discal cell into the base of the fourth posterior cell. Length male 18 mm., female 27 mm., wing 19 mm.

Habitat: San Diego, Cal. 20 males, 8 females.

***Tipula pyramis* n. sp.**

Brownish yellow; head yellowish, cinereous above, with a median darker line; palpi yellow, last segment darker; first three segments of antennae yellow, others brown; dorsum of thorax light yellowish brown, with four broad, brown stripes, the anterior ends of each of which curve slightly outward; between the median pair is a narrow, indistinct brown line; metanotum, pleura and coxae grayish pruinose; halteres yellow, knobs brown, tips lighter; legs brownish, base of femora yellowish; abdomen brownish yellow, darker posteriorly with three brown stripes which are broader and browner posteriorly; eighth sternite somewhat produced posteriorly, posterior margin with a rather broad, elongated round-tipped flap which is margined with yellowish hairs; above this flap, attached to the inner (upper) surface of the eighth sternite and to the anterior margin of the ninth sternite is a long, flat, tapering, slender process the curved tip of which hooks into the median incision of the posterior margin of the ninth sternite; ninth tergite short, leaving the appendages unusually exposed, divided by a deep V-shaped incision and a dorsal median furrow from which arises a short, conical light-colored process; ninth sternite elongated, posterior margin with a deep incision in which, arising from the margin just below the pleural suture, is a pair of long, slender pointed appendages; pleural suture very short; first pair of appendages rather short, stout, curved forward near the middle; second pair with the edges rolled up, ending in two black teeth; third pair unusually large, narrow at the base, broad in the middle, tapering to a blunt point, on the posterior margin near the base are two blunt teeth; wings hyaline, costal and subcostal cell with a yellowish tinge; stigma brown; a broken, whitish band beginning in front of the stigma and reaching through the discal cell into the base of the fourth posterior cell. Length 19 mm., wing 19 mm.

Habitat: Pyramid Lake, Nev. 7 males.

***Tipula sylvicola* n. sp.**

Brownish-yellow; head yellowish, cinereous above; palpi brown, first segment yellow; first three segments of antennae yellow, others brown, somewhat darker at the base; dorsum of thorax grayish brown with three broad, brown stripes, the median one divided by a gray line; scutellum light yellow with a faint median brown line; metanotum and pleura yellowish, pruinose; halteres yellow, knobs brown, tips lighter; legs yellow, tips of femora tibia and tarsi darker; abdomen brownish

yellow, darker posteriorly, the darker dorsal and lateral stripes faintly indicated; posterior margin of eighth sternite with a very broad, rounded incision, middle portion with a narrow white membrane from which arises two brushes of very long, reddish yellow hair; lateral angles with more strongly chitinated, triangular, inward-projecting appendages, the tips and inner margins of which are furnished with yellow hairs; posterior margin of ninth tergite with a broad shallow incision and with a less strongly chitinated yellow border which is quite distinctly set off from the rest of the tergite, the middle of this border is provided with a pair of blackish triangular teeth, the inner margins of which are straight and close together; ninth sternite with a deep narrow U-shaped incision in the upper part of which hangs a pair of tumid, yellow appendages; pleural sutures complete; upper pair of appendages spatulate, yellow, furnished with brownish and yellow hairs; second pair broad, yellow, black-tipped; third pair elongate, tips rounded, margins reddish brown; wings hyaline; stigma brown, a broken whitish band beginning in front of the stigma and extending across the discal cell into the base of the fourth posterior cell. Length 16 mm., wing 17 mm.

Habitat: Keyport, Wash. 5 males (Type). S. Cal. 1 male.

***Tipula unguata* n. sp.**

Brown; head yellowish, cinereous above, with a median darker line; palpi brown, first segment yellow; first three segments of antenna yellow, third brown toward the tip, other segments brown; thorax grayish pruinose; dorsum with three brown stripes, the median one divided by a gray line; scutellum yellowish with a median brown line; halteres yellowish, knobs brown, tips lighter; legs yellowish, tarsi, tips of femora and tibia brown; abdomen yellowish brown, darker posteriorly with three distinct brown lines; eighth sternite with a slight, rounded incision from which arises two tufts of reddish yellow hair; posterior lateral angles with large more strongly chitinated appendages, the posterior face of which is mostly black, ending in a broad, blunt, outer tooth and an inner, narrower, sharper tooth; posterior margin of ninth tergite with a rounded incision in the middle of which are two short, sharp points; ninth sternite divided by a deep, broad U-shaped incision in which hangs a pair of yellowish pendulous appendages and from which projects a pair of conspicuous, strongly chitinated, claw-like appendages; pleural suture complete; first pair of appendages rather broad, brown, tip rounded, with long brown hair; second pair broad, flattened, outer face with a more strongly chitinated fold; third pair elongate, narrowed in the middle, tip rounded; abdomen of female very long, ovipositor reddish brown, upper valves long, acute, tips slightly curved, lower valves long, broad, tips truncate, slightly roundly emarginate; wings hyaline with a brownish tinge; costal and subcostal cell yellowish; stigma and a very narrow border on the great cross vein and the tip of the fifth vein brown; a whitish band beginning in front of the stigma and extending across the discal cell into the base of the fourth posterior cell; and indistinct whitish spot beyond the stigma. Length male 15 mm., female 23 mm., wing 16 mm.

Habitat: San Diego, Cal. 16 males, 4 females.

***Tipula bifalcata* n. sp.**

Yellow; head yellow, cinereous above with a median, darker line; palpi yellow, tips somewhat darker; first and second segments of antennae yellow, others brown; dorsum of thorax honey yellow, stripes very faintly indicated; rest of thorax yellowish, pruinose; halteres yellow, knobs brown; legs yellow, tips of femora, tibia and tarsi darker; abdomen yellow at the base, brownish posteriorly; eighth sternite produced, narrowed posteriorly; posterior margin with a shallow broad, rounded incision from the middle of which arises a tuft of short, thick, stiff, yellow hairs; lateral angles with a pair of conical processes, the tips of each of which are furnished with a pair of close-set, long, heavy, curved, reddish bristles and several shorter yellow hairs; ninth tergite with a deep median furrow, posterior margin ending in a pair of short, broad, blunt, black teeth, between which is a square incision; posterior lateral angles inflexed; ninth sternite with a deep shield-shaped incision from the sides of which arises a pair of rectangular plates which are imbedded in the membrane and to the tips of which are attached the two-parted base of the long, strongly curved, deeply furrowed, two-pointed guard; just below the end of the pleural suture, which is indicated only at the posterior margin, hangs a pair of flat, truncate appendages, the lower edges of which are furnished with long, thick, reddish yellow hair; posterior margin of pleura with a very slight rounded incision; first pair of appendages long, slender, yellow, curved backward near their middle, tips with long yellow hairs; second pair broad, flattened, base narrower, anterior margin strongly chitinized, with a sharp triangular tooth at the tip and a long, narrow spine near the base of the appendage; inner faces with a series of fine chitinous ridges; third pair well separated from the second, spatulate with anterior angle drawn out into a broad, blunt point; arising from the same common base as the other appendages is a fourth pair of strongly chitinized appendages each consisting of a broad base and a long, regularly upward-curved, tapering hook; wings hyaline; costal and subcostal cell lightly tinged with yellow; stigma brown, indistinct; a faintly indicated whitish spot in front of the stigma. Length 18 mm., wing 19 mm.

Habitat: San Diego, Cal. 1 male.

***Tipula biarmata* n. sp.**

Like *T. bifalcata* with the following exceptions: third joint of antennae mostly yellow; dorsum of thorax lighter yellow; the posterior margin of the ninth tergite without the median square incision; the truncate appendages just below the end of the pleural suture are more tumid; third pair of pleural appendages elongate, narrow, of the same width throughout; fourth pair of appendages flatter, shorter, less strongly curved; a distinct whitish band beginning in front of the stigma and extending across the discal cell into the base of the fourth posterior cell. Length 18 mm., wing 19 mm.

Habitat: Keyport, Wash. 1 male.

***Tipula sternata* n. sp.**

Yellow; head yellow slightly darker above; palpi brown, yellow at the base; first two segments of antennae yellow, third brownish yellow, others brown; dorsum of thorax yellow with three brown stripes faintly indicated; scutellum, metanotum and pleura yellowish; halteres brown, base yellow, knobs brown, tips lighter; legs yellow, the tarsi and the extreme tip of the femora and tibia a little darker; abdomen yellow at the base, brownish yellow posteriorly, the three brown stripes only faintly indicated; eighth sternite extending well up on the sides of the abdomen and much produced posteriorly, posterior margin rounded, upper (inner) surface with a median pair of short brush-like tufts of hair and a lateral pair of large whitish, membranous appendages which end in strongly chitinized brown triangular tips; ninth tergite very large about as broad as long, posterior lateral angle produced into a pair of thick heavy, slightly curved pointed horns; posterior margin with two broad, flattened, black-edged teeth between which is a small rounded incision; ninth sternite about concealed by the eighth sternite, only the sides showing; posterior margin with a double incision the heart-shaped anterior part being connected with the rounded posterior part by a narrow channel; in the middle of the heart-shaped part lies the two slender, curved, round-tipped processes which branch off from the base of the guard, the guard itself being long, shield-shaped and with seven black teeth or spines toward the tip, the largest and longest arises from the middle line of the posterior face not far from the tip; pleura very small, suture complete; first pair of appendages small, whitish, spatulate, tip with brown hairs; second pair flattened, posterior margin rounded, anterior margin more strongly chitinized, black, ending in a heavy triangular tooth with a much smaller spine just before it; third pair closely joined to the second forming a rounded lobe on its posterior margin; wings hyaline, costal and subcostal cells and stigma with yellowish brown tinge; veins brown. Length 17 mm., wing 18 mm.

Habitat: Stanford University, Cal. 2 males.

***Tipula tergata* n. sp.**

Brown; head yellowish, somewhat cinereous above; palpi yellow, last segment brown; first two segments of antennae yellow, the third yellowish, brownish toward the tip, other segments brown, slightly swollen at the base; dorsum of thorax light yellowish brown with four distinct brown stripes; scutellum and metanotum light brown with a median darker line; pleura grayish, pruinose; halteres yellow, knobs brown, tips lighter; legs brown, coxae and basal portion of femora yellow; first two or three segments of abdomen yellowish, others brownish, posterior margin of each light yellow; eighth sternite very large, the broad posterior margin with a very slight rounded incision, the narrow, whitish membrane at the middle provided with two tufts of reddish yellow hair; lateral angles with irregular-shaped appendages, ending in an upper blunt and a lower sharper lobe, the posterior faces strongly chitinized; ninth tergite large, about as broad as long, posterior latera

angle produced into two long, triangular processes, the tips of which are slightly curved and acute; on the posterior margin at the base of the inner face of these processes is a pair of short, black, blunt projections; ninth sternite divided by a deep broad membranous depression on the lower margin of which are two small chitinous rings and from the upper portion of which arises the long curved, highly chitinized, beak-like guard; in the lateral margin of this depression just below the pleural suture, which is complete, is a small, short, curved claw, and a short yellow-haired, tumid process; the posterior angle of the pleura produced into a short, broad, triangular point; first pair of appendages small, very light brown, gently curved forward, with reddish brown hair; second pair broad, flat, twisted, ending in a heavy, black, triangular tooth; third pair broadly joined to the second, elongate, distal half suddenly narrowed; wing hyaline, costal and subcostal cell yellowish; stigma brown; a faint whitish spot in front of the stigma; Length 17 mm., wing 17 mm.

Habitat: Pyramid Lake, Nev. 2 males, (Type). S. Cal. 1 male.

Similar in appearance to *T. sternata* but differs in the markings of the thorax and the details of the structure of the hypopygium.

Tipula flavicoma n. sp.

Yellow; head yellow with a narrow brown stripe above; rostrum yellow; first three segments of palpi yellow, last segment brown; first three segments of antennae yellow, fourth segment yellowish brown, others brown; metanotum brownish yellow with thin indistinct brown stripes, the median one divided and faintly bordered by darker brown; pleura light yellow, pruinose; scutellum and metanotum yellow; halteres yellow, knobs brown; legs yellow, tarsi and tips of femora and tibia darker; abdomen yellow with distinct brown lines above and on the sides, the latter wavy; eighth sternite somewhat produced posteriorly, posterior margin truncate with a fringe of light yellow hairs; inner sides of the lateral angles, which are somewhat produced, with tufts of long yellow hair; ninth tergite with a median rather broad U-shaped incision and lateral very slight rounded incision; ninth sternite with a very deep, broad, rounded incision in which hangs a pair of long, yellow, tumid, hairy appendages; pleural suture complete, the upper portion faintly marked, posterior margin of pleura with a broad, shallow, rounded incision; first pair of appendages small, spatulate, second pair broad, twisted, tips black, third pair broad, flat, tips rounded; wing hyaline; veins and subcostal cell yellowish; stigma brownish, rather indistinct; a whitish interrupted band beginning in front of the stigma and extending across the discal cell into the base of the fourth posterior cell; indistinct whitish spots in the second basal, anal, and axillary cells. Length 17 mm., wing 16 mm.

Habitat: Montana. 1 male.

***Tipula biuncus* n. sp.**

Brownish yellow; head yellowish, cinereous above with a median darker line; palpi yellow, first two segments of antennae yellow, others brown; dorsum of thorax cinereous with three median brown lines and two lateral broader brown stripes; dorsal pleural membrane yellow; pleura grayish, pruinose; halteres yellow, knobs brown, tips lighter; legs yellow, tarsi and the tips of the femora and tibia brown; abdomen brownish yellow with three brown stripes, the dorsal one broad and distinct the lateral ones broken; posterior margin of eighth sternite with a very slight, rounded incision with a few reddish yellow hairs; ninth tergite with a very deep V-shaped incision; posterior lateral angles sharp-pointed; ninth sternite divided by a deep, broad furrow in which hang two very short, tumid, yellow appendages; pleural sutures complete; lower angle of pleura produced into a short, blunt point; first pair of appendages broad, spatulate, brown, thickly covered with brown hair; second pair flattened, black-tipped, third pair closely joined to second, yellowish, rounded; a pair of long, slender, sharp-pointed, slightly curved hooks projects beyond the appendages; base of ovipositor brown, valves yellow; upper valves slender, straight, tips rounded, lower valves broad, triangular, short, not reaching half way to the tips of the upper valves; wings hyaline; subcostal cell tinged with yellow; stigma brown; a very faintly indicated broken whitish band beginning in front of the stigma and extending across the discal cell into the base of the fourth posterior cell. Length male, 12 mm., female 15 mm., wing 13 mm.

Habitat: S. Cal. 1 male, 1 female.

***Tipula meridiana* n. sp.**

Gray; head grayish, darker above; rostrum grayish above, brownish on the sides; palpi brownish; metanotum light yellowish with three broad, ashen stripes, each of which are distinctly brown bordered and the middle one divided by a narrow brown line; pleura, scutellum and metanotum grayish, pruinose, latter with a median brownish line; halteres yellow, knobs brownish at the base; legs brownish yellow, tarsi darker; abdomen brown; eighth sternite distended below to make room for a rather large, tumid appendage that arises from the ventral side of the base of the ninth sternite; ninth sternite with a deep V-shaped incision and a median suture which extends to the base of the segment; pleural suture complete setting off a large rectangular sclerite, the posterior ventral corner of which is extended into a blunt point which bears the appendages; the first pair of appendages somewhat ovate, second pair broad at the base, distal half twisted and more strongly chitinized; posterior margin of ninth tergite with two close-set, black-tipped, blunt projections; wings almost hyaline with a slight brownish tinge; an indistinct whitish stripe in the first basal cell extending through the first posterior cell to the tip of the wing; all the veins with a more or less distinct brown border. Length 11 mm., wing 15 mm.

Habitat: Arizona. 1 male.

Tipula spatha n. sp.

Yellow; head yellow slightly darker above; palpi yellow; first two segments of antennae yellow others wholly brown; mesonotum yellowish brown with three brown stripes, the median one divided by a lighter line; pleura yellow, pruinose; scutellum and metanotum yellow; halteres brown, base yellow, tips of knobs yellowish; legs yellow, tarsi and tips of femora and tibia darker; abdomen yellow, darker posteriorly, posterior margin of each segment lighter; eighth sternite very large, brownish yellow; posterior margin with a median rectangular projection, distal side of which is fringed with short yellow hairs; laterad of this is a pair of club-shaped appendages the tips of which are provided with long, stiff, reddish hairs; ninth tergite divided by a deep, V-shaped incision and a deep furrow which reaches to the anterior margin where it widens considerably, the posterior margin ending in two sharp downward-projecting points; posterior margin of ninth sternite with a very deep, broad, U-shaped incision from the anterior margin of which arises a long, rather broad and tumid, light yellowish process; pleural suture complete, setting off a rather large rectangular sclerite; upper appendage broad, flat, rounded, base narrower, margins with long yellow hairs; second appendages broad, thin, margins with fine black hairs; below the pleural suture is a pair of tumid appendages which bear long yellow hairs; between these, projecting from the genital chamber are three long, strongly chitinized organs, the upper pair are long, narrow, sharp-pointed, the lower one is wider and has a broad, downward-projecting tip; wings hyaline, subcostal cell yellowish, a whitish band beginning in front of the stigma and extending across the closed cell into the base of the fourth posterior cell; stigma brown; fifth vein narrowly bordered with brown. Length 23 mm., wing 22 mm.

Habitat: Arizona. 1 male.

Tipula occidentalis n. sp.

Brownish yellow; head yellowish, cinereous above with a median darker line; rostrum yellowish at the base, brownish toward the tip; first three segments of antennae yellow, others brown, darker at the base, distal end of segments 4, 5, 6, 7, more or less yellowish; dorsum of thorax light yellowish, with three brown stripes, the median one divided by a light line; scutellum and metanotum very light brown with a median brown stripe, sides of metanotum brown; pleura very light yellow, with indistinct grayish spots; halteres yellow, knobs brown, tips lighter; legs yellow, tips of the femora, tibia and tarsi darker; abdomen brownish yellow, darker posteriorly, with three distinct brown stripes, the dorsal one the broadest; posterior margin of each segment whitish; posterior margin of eighth sternite with a rounded incision from the middle membranous portion of which arises two brushes of rather long, yellow hair; lateral angles with triangular hooked appendages the tips of which are furnished with a few yellow hairs; ninth tergite with a very broad, deep, V-shaped incision; ninth sternite divided ventrally by a rather

broad, membranous portion, posterior margin with a broad, shallow U-shaped incision in which hangs a pair of tumid, yellow, hairy appendages; pleural suture complete; first pair of appendages brown, furnished with brown hairs, long, gently curved near the middle, tip rounded; second pair broad, more strongly chitinized, ending in two strong, blunt points; third pair closely joined to the second, quadrate, yellow, less strongly chitinized; wings hyaline with a faint brownish tinge; the stigma and faint spots over the tip of the subcostal vein and the origin of the præfurca, brown; the whitish band beginning in front of the stigma extending across the discal cell into the base of the fourth posterior cell. Length 15 mm., wing 17 mm.

Habitat: San Diego, Cal. 6 males.

***Tipula flavocauda* n. sp.**

Brown; head yellowish brown, cinereous above; palpi yellow, last segment brown; first three segments of antennæ yellow, others brown, darker at the base; dorsum of thorax gray with four brown lines; scutellum, metanotum, pleura and coxæ grayish pruinose; halteres yellow, knobs brown; legs yellow, tibia and tarsi darker; abdomen yellowish brown with three broad, brown stripes; posterior margin of eighth tergite with a median tuft of short, light yellow hairs between a pair of irregular-shaped, six-sided, box-like appendages which, when folded in place, show only one of the broadly triangular surfaces; ninth tergite brown, posterior and lateral margins yellow; posterior-lateral angles produced into two broad, truncate projections each bearing on its ventral side a short, sharp, triangular tooth; between the lateral projections and separated from them by small rounded incisions is a median pair of short, sharp-pointed, broadly triangular projections; posterior margin of ninth sternite with a rounded incision from the membranous middle portion of which arises a pair of rather prominent, strongly chitinized, horn-like projections; above these, usually concealed by the pleural appendages, is a group of four other chitinous appendages, the lateral pair long, slender, sharp-pointed and bent at right angles near the center, the upper member of the group is strong and beak-like, the lower member weak, slender and hooked at the tip; in the lateral margins of the incision, just below the pleural sutures is a pair of very short, yellow, tumid appendages the tips of which are furnished with yellow hairs; pleural sutures complete, posterior margin of pleura with a short triangular tooth; upper pair of appendages slender, whitish with many brown hairs; second pair brown, flat, ending in a sharp, heavy, black, triangular point; third pair closely united to the second, consisting of two lobes the anterior one sharp-pointed, the posterior one truncate; upper valves of ovipositor long, tips rounded and slightly curved upward; lower valves weakly chitinized, short, reaching only to the base of the upper valves; wings hyaline, costal and subcostal cells, the stigma and the veins brown. Length 16 mm., female 20 mm., wing 17 mm.

Habitat: San Diego, Cal. 3 males, 3 females.

CHANGE OF NAMES.

Mr. C. P. Alexander has recently called my attention to the fact that some of the names that I used in describing certain *Tipula* in my article in Jour. N. Y. Ent. Soc. Vol. IX No. 3 (1901), were preoccupied. Some of these I had noted before but had neglected to change them. I now wish to propose the following changes:

Page 107, for *Tipula clara* substitute *T. pellucida*.

Page 115, for *Tipula concinna* substitute *T. olympia*.

Page 119, for *Tipula albocittata* substitute *T. vittatipennis*.

Page 121, for *Tipula contaminata* substitute *T. commiscibilis*.

Page 124, for *Tipula graphica* substitute *T. fulvilineata*.

A PROBLEM IN THE FLIGHT OF INSECTS.

HERBERT OSBORN.

In the usual explanations for the flight of insects, the mechanism is considered essentially as a plane with a rigid anterior border, flexible hinder border and with a vertical movement so that the vibrations result in the forward propulsion of the insect and, so far as I am aware, no further discussion of the modes of progression have been presented. There is, however, another feature in the flight of insects which appears to me to be well worthy of notice and which is not explained by the application of these principles, at least without some modification. Insects, aside from the direct forward flight, are able to hover or even fly distinctly backward as of course everybody who has observed insects must have noticed. It is only necessary to recall the hovering flight of swarms of insects in the air, such as midges, gnats, certain species of flies, May-flies, and even grasshoppers, to appreciate the distinctness of this feature of flight. For a distinctly backward progression, we may cite the approach and retreat of the hawk moths in their visits to flowers, the backward and forward movements of bees as they light or rest upon plants, the dragon-flies, and perhaps especially the backward flight of the honey bee in its initial flight from the hive when it is fixing the location of the entrance to its hive.

Now if we consider the mechanism of the wing as simply a membrane with a rigid anterior border and the progression

effected by the up and down movement of this membrane, the propulsion being determined by the flexibility of the posterior border, it will be seen that while this device provides beautifully for the forward progression of the insect, it does not account for such backward movements as have been noticed. This problem has been in mind for several years and I have presented it on a number of occasions to my classes in Entomology and it has provoked a good deal of discussion, and it appears to me that it is possible to offer an explanation which may be considered somewhat of a solution of the problem. This solution has been suggested and contributed to by a number of students in these discussions and it may be difficult to credit the explanation to any original source.

The explanation of these movements seems most readily accounted for on the basis of an adaptation in the wing which provides for a forward and backward movement so that the angle of the wing with reference to the axis of the body represents different degrees ranging from a right angle to an angle of 30 to 45 degrees for the anterior quadrant. It will be seen that when rotating forward in this manner, the rigid portion of the anterior part of the wing is shifted so that the flexible apical and posterior margins have a different extent and must present a varying pressure upon the air. It appears quite certain that this rotation would allow for varying degrees of the forward and backward pressure, or to state it in another way that the direction of force of each wing would form an angle to the median axis of the body, and that at the point where these would neutralize each other, the effect would be to produce a stationary condition of the insect whereby it would hover at a fixed point, and that a slight further rotation forward would serve to push the insect in a backward direction.

That this mechanism actually exists in many insects may be determined by the movement of the wing forward or backward in a horizontal plane, and it is easily noted in the position in which wings are fixed at death in many insects. Comparison among different groups of insects will show that the extent of rotation differs greatly in different groups and this would agree thoroughly with the fact that the ability to hover or to retreat in flight is very differently developed in different insects. Furthermore, it appears that the ability for this kind of flight depends in some degree upon the shape and especially upon

the width of the wings, as it will readily be recalled that the broad winged moths and butterflies show little if any flight of this character, whereas the narrow winged hawk moths, flies, bees, etc., which have the property distinctly developed are mostly narrow winged species. Furthermore, it seems that the development of lobes or other variable extensions of the membrane on the posterior border may be significant in this connection. An exhaustive comparison amongst different species of insects, and careful reference as to the extent to which hovering or backward flight is possessed by the different species would be an interesting matter in this connection, but the author has not had time to devote to such a research and the problem is presented here rather as a suggestion for investigation than with the idea that it has been exhausted.

FAUNISTIC STUDIES IN ENTOMOLOGY.

HERBERT OSGORN.

I desire to call attention in this note to the desirability of more extensive and especially more distinctly correlated studies upon the insect fauna of the country and especially with reference to the localities represented by the members of this society.

There is no question, I think, as to the great desirability of studies on the geographical distribution of insects, but I have been particularly impressed with the necessity for such studies and the desirability that it should be pushed to greater intensity by recent efforts to secure data concerning the distribution of the species in a group upon which I have been engaged.

The records of occurrences for insects have always been a quite prominent feature of entomological journals and to a considerable extent, lists of species in certain groups, for certain localities, states, or districts, have appeared in various journals. While the preparation of such lists may by some be considered as a rather easy part of entomological investigations, it appears to me that accurately done work of this kind becomes of the highest scientific value, and that we may very well encourage it to the greatest extent that is possible. Undoubtedly this particular kind of work is one which could be entered upon with the greatest interest and with promise of most distinct

advancement to the science, if brought to the particular attention of the members of this society, and especially for those who are located in places where such studies have been neglected. In many cases such isolated individuals are deterred from undertaking the listing of their native species because of the idea that such work is not of primary importance, or from the difficulties encountered in finding the most satisfactory methods of preparation for various groups or securing the identification of such groups as may lie outside of their own especial field. These conditions may be greatly helped by the distinct stamp of approval of this society for such work and by some concerted effort to arrange so that determinations may be secured for the collections in different orders. The direct method of encouragement, it appears to me, may be best taken up by the appointment of a standing committee on faunistics, the duty of which committee shall be to suggest means for the encouragement of such local work, the assisting of individuals in placing their collections where they may be identified, the gathering of scattered and isolated local lists into more comprehensive ones, either for certain groups of insects or to cover certain geographical districts, or to develop the faunistic study of Entomology in such other ways as they may deem profitable. If this suggestion appeals to the society, I should be pleased to see such a committee organized at this meeting or at such time as may seem appropriate, and given such instruction as the society may see best. In general, it would seem desirable that such lists as have been mentioned should be published in the various journals to which they might be most appropriate, in the proceedings of state academies or other local societies and that the more extended faunistic papers resulting from the collection of these may be finally published in the *Annals* or in such journal as may give to them the widest distribution and permanence.

Some most excellent work of this kind is in progress in certain states and I think we will all agree as to the useful purpose that has been served by such extensive state lists as that on New Jersey Insects and many of us have had occasion to admire and make use of the extensive work in this line carried along by the State Entomologists of Illinois and of North Carolina. These are by no means the only cases of the kind but may serve to illustrate the utility of work in this field.

AQUATIC HYMENOPTERA IN AMERICA.

ROBERT MATHESON and C. R. CROSBY.

This article is intended primarily to call attention to an almost entirely neglected field of entomological research, at least in this country, namely—the study of the habits and life-histories of those minute hymenopterous insects that have assumed aquatic life. In Europe considerable work has been done along this line. As early as 1836, F. Walker observed *Agriotypus armatus* (an anomalous Ichneumon fly) descend some distance into the water. Von Siebold (1858), W. Müller (1888), and others have shown that it is parasitic on Trichopterous larvæ. In 1863 Sir John Lubbock published his well known account of *Polynema natans* and *Prestwichia aqualica*, both with aquatic habits, the former swimming by means of its wings, the latter using its legs. Nothing was known by him regarding their earlier stages. Enock, Heymons and Willem have since reared *Prestwichia aqualica* from a variety of insect eggs, including Notonecta, Ranatra, Dytiscus and Pelobius.

In 1908, Heymons reared from eggs of a dragon-fly a Mymarid (*Anagrus subfuscus*) which although provided with wings kept them closed and swam with its legs. He also observed *Gyrocampa stagnalis*, a Braconid, swimming under water by means of its legs. Other European workers have made similar observations on the same or related species.

Our notes refer to three species, all reared at Ithaca, N. Y.

Hydrophylax aquivolans n. gen. and n. sp.

In September, 1908, Dr. J. G. Needham observed a number of minute Trichogrammids swimming by means of their wings in an aquarium which contained eggs of *Ischnura*, probably *verticalis*. These were again observed by him in the summer of 1911. Nothing is known regarding their earlier stages.

This species is apparently undescribed and runs to the genus *Asynacta* Foerster in Ashmead's tables (Chalcis Flies, p. 359, 1904). Foerster used the name *Asynacta* in a table in his Hymenopteren Studien, II, p. 87, 1856, but no species has ever been placed in the genus, and it is therefore a *nomen nudum*. In any case, although the present species agrees with *Asynacta* Foerster in antennal characters it would be separated from that genus by the extremely narrow wings which are abnormal to

that group. For it is only fair to assume that the wings in Asynacta are of the usual type, otherwise Foerster would have mentioned it in his description of the genus.

Hydrophylax. New genus. Antennæ 8-jointed; scape, pedicel, ring joint, 2 funicle joints and 3-jointed club. Fore wing extremely narrow, twenty times as long as wide; marginal cilia at least four times as long as the width of wing. Abdomen conic-ovate, broadly joined to the body. Ovipositor slightly exerted.

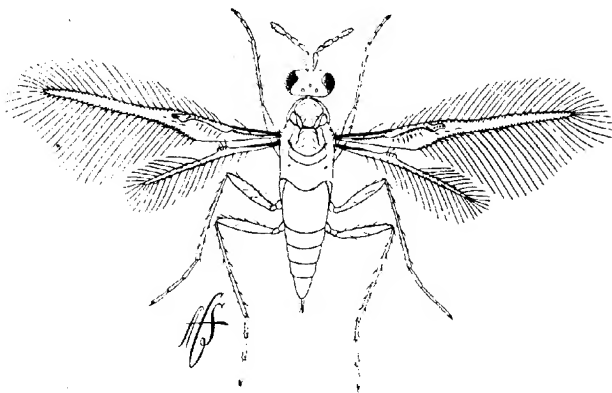


FIG. 1. *Hydrophylax aquivolans*.

Drawn by Miss Anna C. Stryke.

Type. the following species.

Hydrophylax aquivolans. New species. ♀ length .6 mm. Length of fore wing .69 mm.; hind wing .45 mm. (Fig. 1.)

General color light brownish yellow. Legs and antennæ paler. Head seen from above gently concave in front and behind, sparsely clothed with a few stiff setæ. Thorax smooth, clothed with stronger setæ. Scutellum gently rounded behind.

Postscutellum with two fine setæ, close together on each side. Propodeum smooth, without setæ except near the spiracles. Metathoracic spiracles enlarged, with two short, knobbed hairs which appear to arise within the opening.

Abdomen conic-ovate, sparsely clothed with long stiff setæ, broadly joined to the thorax; 5 visible dorsal segments; length of abdominal segments in the ratio of 5, 2, 2, 2, 3. Ovipositor exerted about the length of the shortest abdominal segment.

Antennæ 8-jointed, consisting of scape, pedicel, 1 ring joint, 2 funicle joints and a 3-jointed club. Scape compressed, elongate-oval; pedicel as long as the first joint of funicle and ring joint, elongate-obconic; first funicle joint cylindrical, $1\frac{1}{2}$ times as long as the second; second slightly oval; club elongate-oval, 1-5 longer than the funicle. Anterior and middle femora slightly enlarged medially, the posterior femora more distinctly enlarged. Anterior and middle tibiæ of about same width throughout. Posterior tibiæ somewhat enlarged distally and slightly narrowed just before the tip. First and second posterior tarsal joints of equal length, the third somewhat shorter.

Front wings very narrow, 20 times as long as broad. Marginal cilia very long and evenly spaced, those on the posterior margin four times as long as the wing is wide. Marginal cilia are interspersed with a submarginal row of short setæ.

♂ Length .6 mm. Similar to the female. Antennæ 8-segmented, consisting of a scape, pedicel, a ring joint, 5 funicle joints, the last three more closely united. Scape compressed; pedicel obconic; ring joint distinct; first funicle joint about $1\frac{1}{2}$ times longer than second, thicker at base than apex. The remaining joints sub-equal in length, the last two thicker than the preceding. Apical joint pointed at tip. Antennæ clothed with stiff setæ, which are longer than those of the female.

***Limnodytes gerriphagus* Marchal.**

On June 16, 1911, we reared a species of Proctotrypidæ from the eggs of a water strider (*Gerris remigis*). Both males and females were observed swimming actively under water by means of their wings. They readily broke the surface film and made their escape flying in the air. They were observed to re-enter the water and examine carefully the surface of the leaf as if searching for the eggs of their host. The eggs of *Gerris* are laid in a single row in gelatine on the under side of the floating leaves of aquatic plants. The females were observed ovipositing in the eggs of *Gerris*. In the field several of these parasites were found on the under side of a floating leaf on the egg mass of *Gerris*. Only a single parasite emerged from each egg.

We have determined this species as *Limnodytes gerriphagus* Marchal, described in 1900 from specimens reared from the eggs of *Gerris* collected in the vicinity of Paris. Although our specimens agree with his descriptions and figures, yet to be

certain of our identification we have sent specimens to Dr. Marchal for comparison. In a letter of February 9, 1912, Dr. Marchal informs us that our specimens are identical with *Linnodytes gerriphagus*.

***Caraphractus cinctus* Walker.**

On December 7, 1911, we collected some aquatic plants (*Ludvigia palustris*) from a small pond at Ithaca, in the stems of which we found an abundant supply of the eggs of one of the back swimmers (*Notonecta*). Over half of these eggs contained larvæ of a Hymenopterous parasite in which could be observed the legs and antennæ of the developing pupæ. Four to five larvæ were found in each egg. The heads of all did not point in the same direction. Plant stems containing a supply of these eggs were kept in aquaria in a warm room and on December 19, some young back-swimmers had hatched and were swimming actively about. Adults of the parasite had also emerged and were observed to be actively swimming in the water. One of the parasitized eggs was removed from the stem and placed under the microscope. It contained four adults, one of which, a male, was beginning to gnaw a hole in the end of the egg shell. This male emerged within five minutes, and taking a position on the top of the egg shell stripped off the pupal sheath from antennæ and legs. This one was followed by a second male and two females, all emerging within nine minutes through the same opening.

The adults of this species seem perfectly at home under water and swim quite rapidly by means of their wings with a jerky motion, corresponding to the wing strokes made at the rate of about two per second. The legs are trailed behind and are not used in swimming. They spend much of their time walking nervously over the stems of submerged plants, the surface of which they examine carefully with the tips of their antennæ, as if searching for eggs in which to oviposit. They are able to walk on the sides of the glass aquaria and on the under side of the surface film. After transferring a jar of water containing these parasites from one building to another a number were found on the upper side of the surface film in the air and flew across the surface trailing their legs attached to the film. They emerge from the water by crawling up some object and forcing their way through the surface film. (Fig. 2.)

In three cases we observed males and females apparently in copulation under water on the stems of the plants. We have not had opportunity to observe oviposition although females have been seen several times attempting to insert the ovipositor in the eggs of *Notonecta* which were nearly ready to hatch.

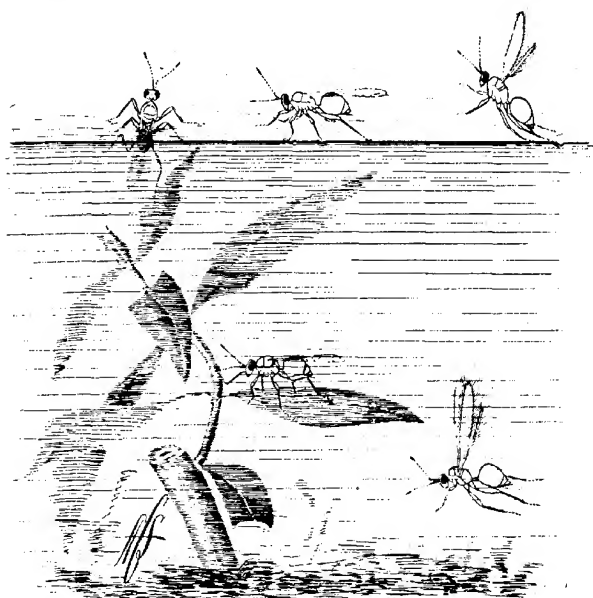


FIG. 2. *Caraphractus cinctus* Walker.

Drawn from life by Miss Anna C. Stryke.

We have been unable to see any external air supply carried by these insects while under water. While submerged they appear to be perfectly wet but as soon as they emerge into the air they seem to be perfectly dry. They are able to live submerged in water for over 12 hours in a bottle filled full of water and corked.



FIG. 3. Egg of *Caraphractus cinctus* Walker.

The egg of *Caraphractus cinctus* as dissected from the female is white, elongate-ovate, and provided with a short pedicel at its larger end (Fig. 3). Length .16 mm.; width .043 mm. The ovaries contain a large number of eggs.

Caraphractus cinctus Walker is an older name for *Polynema natans* Lubbock. Upon finding that our specimens agreed with the figures and description of the latter as given by Lubbock (1863) we forwarded specimens to him for identification. Lord Avebury kindly sent these specimens to Mr. Fred Enock for comparison with British examples. After examination Mr. Enock informs us that he is of the opinion that they are identical.

LIST OF KNOWN AQUATIC HYMENOPTERA.

CHALCIDIDÆ.

Prestwichia aquatica Lubbock, 1863. Parasitic on the eggs of *Notonecta*, *Ranatra*, *Dytiscus*, and *Pelobius*.

Hydrophylax aquivolans Matheson and Crosby, 1912. Parasitic on the eggs of *Ischnura*. (New York).

PROCTOTRYPIDÆ.

Limnodytes gerriphagus Marchal, 1900. Parasitic on the eggs of *Gerris* spp. (France and New York).

Limnodytes setosus De-Stefani Perez, 1902. Parasitic on the eggs of *Gerris* sp. (Sicily).

MYMARIDÆ.

Caraphractus cinctus Walker, 1846. (*Polynema natans* Lubbock, 1863). Parasitic on the eggs of *Notonecta*. (England and New York).

Anagrus subfuscus Heymons, 1908. Parasitic on the eggs of *Calopteryx virgo* L. (Germany).

BRACONIDÆ.

Gyrocampa stagnalis Heymons, 1908. Host unknown. (Europe)

Dacnusa rousseaui Schulz, 1907. (Europe).

Chorebus natator Schulz, 1907. (Europe).

AGRIOTYPIDÆ.

Agriotypus armatus Walker, 1836. Parasitic on larvæ of Trichoptera.

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RESOLUTIONS

ON THE DEATH OF SAMUEL HUBBARD SCUDDER.

It is with profound sorrow that we record the death on May the 17th, 1911, of Dr. Samuel Hubbard Scudder. Born of fine lineage in the city of Boston on April the 13th, 1837, he was graduated at Williams College in 1857, taking the degree of B. A., and in 1862 from Harvard, taking the degree of B. S. He was one of the favorite pupils and assistants of the late Professor Louis Agassiz. He was the Secretary of the Boston Society of Natural History from 1862 until 1870, during much of this period being also the Curator of the Museum; and from 1880 to 1887 he served as the President of the Society. From 1879 to 1882 he was the Assistant Librarian of Harvard University. From 1886 to 1892 he held the position of Paleontologist of the United States Geological Survey. His scientific and literary industry was prodigious. His entomological works deal principally with the Lepidoptera, the Orthoptera, and fossil insects. He placed American biologists under everlasting indebtedness to him by the preparation of the "Nomenclator Zoologicus", and by many bibliographies and indices. His great work "The Butterflies of the Eastern United States and Canada with special Reference to New England", and his magnificent volumes upon the "Pretertiary and Tertiary Fossil Insects of North America" will always remain classical. Honors were abundantly bestowed upon him by learned societies both in America and Europe, and he received many richly deserved academic degrees.

Reviewing his work in its entirety, it constitutes one of the most notable contributions made by a single individual to the literature of biological science during the past fifty years. It is a monument attesting the vast learning and the colossal industry of a man, who in circumstances which did not entail upon him the necessity for labor, dignified his life by consecrating his noble powers to the advancement of human knowledge. Though suffering the keenest domestic bereavements, and during the last years of his life compelled to undergo a living martyrdom through paralysis both of hands and feet, he preserved to the last his cheerful disposition and an unclouded intellect. His death came as a gentle release from suffering, leaving our Society and the world the richer by his example of patience and the fruits of his toil; the poorer by his removal hence.

(Signed)

W. J. HOLLAND,
C. J. S. BETHUNE.



DR. S. H. SCUDDER



DR. HENRY C. MCCOOK

RESOLUTIONS

ON THE DEATH OF HENRY CHRISTOPHER MCCOOK.

The Reverend Doctor Henry Christopher McCook, an Honorary Fellow of this Society, died at his home in Devon, Pennsylvania, October 31, 1911.

It is fitting that those persons, members of the Society, interested in the same studies that he pursued with such success, for so many years, should place on record their sorrow for the loss of an American pioneer in the study of social insects, who added so much to our knowledge of these creatures and by his many attainments shed lustre on American Entomology. He had a profound love and enthusiasm for all nature; a keen observer, he had the literary ability to translate his observations into word pictures that are an ornament to the literature of Entomology.

He believed that study of the structure, conditions and behavior of all created things highly tends to elevate human character, and we can truly say that our departed friend was a shining example of this fact. He was also distinguished in ways other than in Entomology and we have lost a profound scholar, a deep thinker, an able observer, a great educator, a genial companion and friend, a noble man.

His life work is finished, but what he accomplished still lives and will continue to live, as its foundation is truth and its keystone nature's law.

(Signed)

HENRY SKINNER,
PHILIP P. CALVERT,
HENRY L. VIERECK.

RESOLUTIONS

ON THE DEATH OF HENRY ULKE.

WHEREAS, By the death of Henry Ulke the Entomological Society of America has lost one of its most illustrious Honorary Fellows; and

WHEREAS, Mr. Ulke was known not only for his marked ability as an entomologist and collector, but for his delightful personality and genial temperament; and

WHEREAS, His personal enthusiasm has largely helped to develop American entomology, and to encourage the studies of others; therefore be it

Resolved, That the Entomological Society of America express, through these resolutions, its sorrow at this loss to American entomology; and be it further

Resolved, That we express to the world our admiration of his industry as a collector, our respect for his entomological knowledge, and our high estimation of his character.

(Signed) A. D. HOPKINS,
 E. A. SCHWARZ,
 L. O. HOWARD.

RESOLUTIONS

IN MEMORY OF DANIEL WILLIAM COQUILLETT.

Daniel William Coquillett, a fellow of the Entomological Society of America, died at Atlantic City, New Jersey, the 8th of July, 1911. Born on a farm at Pleasant Valley, Illinois, 23rd January, 1856, he showed, in early life, much interest in birds and insects, and began rearing Lepidoptera and publishing accounts of their larvæ. Compelled by ill health to go to California, he there began the study of Diptera which he continued until the time of his death, having attained world-wide recognition as an earnest, industrious and independent student, and the leading place in American Dipterology, namely; Curator of the collections of Diptera in the United States National Museum. By his painstaking work on difficult and little known groups of his specialty he laid the foundation that will be of use in future years.

His work in economic entomology, particularly the colonization of the *Vedalia* lady-beetle, and the discovery of the hydrocyanic acid gas process, has been of inestimable value to horticulture.

His kindness of heart, his uniform courtesy and his willingness to aid others awaken us to the great loss that has befallen entomology in general. In admiration of his technical ability and in honor of his unselfishness as a man, we record this appreciation of his life and work.

NATHAN BANKS,

C. W. JOHNSON,

JAS. S. HINE,

Committee.

PROCEEDINGS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA.

Washington Meeting.

The sixth annual meeting of the Entomological Society of America was called to order by President Herbert Osborn at 10:00 a. m., Tuesday, December 26, in Room 376 of the new U. S. National Museum building. The following committees, appointed previous to the meeting, reported:

Committee to draft resolutions on the death of Dr. Henry Christopher McCook—Henry Skinner, P. P. Calvert, Henry L. Vierick. Report accepted and ordered printed.

Committee to draft resolutions on the death of D. W. Coquillett—Nathan Banks, C. W. Johnson, J. S. Hine. Report accepted and ordered printed.

The chair was directed by motion to appoint the following committees: Committee on Resolutions; Committee on Nominations; Auditing Committee.

The following papers were read, of which abstracts are given for those not to appear in the ANNALS:

Herbert Osborn. *Faunistic studies in entomology*. (Printed in this number of ANNALS).

E. P. Felt. *Numerals as aids in classification*. The habitual use of numbers in catalogues indicates utility. A modified system of decimal notation is adapted to the needs of naturalists, while additions require little change. A general agreement upon the numbers for the major zoological division is suggested prior to the application of the system by cataloguers and other general workers.

E. S. Tucker. *Studies of insects bred and collected from the American mistletoe*. Presented by Andrew Rutherford—By the name of "American mistletoe", the species *Phoradendron flavescens* Nuttall and its several varieties is meant. Two snout-beetles belonging to the same group as the cotton boll-weevil were bred from terminal enlargements of the stem. From the larvæ of one of these beetles five hymenopterous parasites were bred, all of which attack the larvæ of the cotton boll-weevil. About sixty species in all were obtained.

H. C. Severin. *The influence of temperature on the moulting of the walking-stick, Diapheromera femorata*. Read by title.

The president announced the following committees:

Committee on Resolutions—E. P. Felt, E. D. Ball, and A. A. Cooley.

Committee on Nominations—C. W. Johnson, J. G. Sanders, and H. E. Summers.

Auditing Committee—Henry Skinner, J. H. Comstock, and A. D. Hopkins.

The society then adjourned to meet at 1:30 p. m. Upon reconvening, the following papers were read:

R. Matheson and C. R. Crosby. *Notes on aquatic Hymenoptera*. Illustrated. Presented by C. R. Crosby. (Printed in this number of ANNALS).

Ann H. Morgan. *Photographs illustrating the life histories of May-flies*. Illustrated. Photographs were shown which illustrated the life history and biology of about twenty-five May-flies. Both nymphs and adults were photographed alive; the nymphs in a solution of chloretone, the adults without anæsthetic. Nymphs representing the main biological groups were shown and their habitat described. Imagoes and sub-imagoes of certain genera were shown and their structure and characteristic postures noted.

H. Y. Tsou. *The Chinese wax-scale, Ericerus pe-la*. Illustrated. One of the most beneficial insects of the family Coccidæ has been domesticated by the ancients of the Chinese people for the wax which it produces. This paper consists of (a) correction of errors of European translation from Chinese works; (b) additional statements on the life history of the insect; (c) method of propagating this insect; (d) division of labor in carrying on this industry among the people of different localities, so that the eggs of the insect are produced in the northern district and the wax in the southern district; (e) importance of this industry; and (f) use of the wax.

A. D. MacGillivray. *The lacinia in the maxilla of the Hymenoptera*. Illustrated. (To be printed in the ANNALS.)

Lucy Wright Smith. *Glycogen in insects, especially in the nervous system and the eyes*. Illustrated. In a heterogeneous lot of insects, including representatives of seven orders, glycogen has been found: (1) in immature and adult stages (a) in the crystalline cells of compound eyes, (b) in the crystalline and retinal cells of simple eyes, (c) in the neurilemma; (2) in immature stages only, (a) in the cells of ganglia in all parts of the body. No glycogen has been found in nerve fibers.

J. A. Nelson. *Note on an abnormal queen-bee*. Illustrated. This queen was originally sent from Grand Bay, B. W. I. When received she was alive and quite active. It was planned to introduce her into a hive to test her fertility, but she died by accident before this was done. The dead queen appeared normal in structure with the exception of the abdomen; which was ovoid in shape, instead of conical as in the normal queen; it was also flexed strongly ventrad at the apex, which had consequently a blunt appearance, like that of the abdomen of the drone. The sternites of the 5th and 6th abdominal segments were unusually broad and somewhat asymmetrical, as was also the sternite of the 4th segment. The sternite of the 7th segment was the most modified of all, being greatly shortened in the longitudinal axis, and almost concealed by the sternite of the preceding segment. The notch on its posterior border was abnormally broad and deep. The sting had a slight kink midway of its length.

The internal organs were apparently normal with the exception of the genital organs. The left ovary and oviduct were entirely wanting. The right oviduct and ovary were present, but the latter appeared to possess only a single egg tube. The spermatheca was empty. The bursa copulatrix was also shortened in the longitudinal axis so that the external openings of the spermatheca and the poison glands were brought close together. No characters suggestive of hermaphroditism were found. The cause of the abnormalities is unknown.

J. Chester Bradley. *The designation of the venation of the hymenopterous wing*. Illustrated. In the higher Hymenoptera, owing to certain remarkable conditions that prevail, the full application of the Comstock-Needham system of venation becomes a very complex matter. This is especially true in the case of the hind wings. By certain simple abbreviations this complexity is avoided, and the system becomes quite conveniently usable for taxonomic purposes.

Ann H. Morgan. *Homologies in the wing-veins of May-flies*. Illustrated. (To be printed in the ANNALS).

A. D. MacGillivray. *The pupal wings of *Heptalius thule**. Illustrated. (To be printed in the ANNALS).

J. Chester Bradley. *The wing venation of Chalcid flies*. Illustrated. The hymenopterous family Chalcididae present a uniform excessive reduction in the number of their wing veins

which is approached elsewhere in the Hymenoptera only by certain Proctotrypidæ and Evaniidæ. This depletion is the result of a degenerative tendency that is manifest wherever there is considerable reduction in the size of the wasp. It is of interest to ascertain with what veins of other Hymenoptera the vein remnants in the Chalcid wing are homologous.

The so-called marginal vein is in reality the elongated stigma, the "post-marginal" is r and R_1 and usually bears on its anterior margin a spur of the base of R_3 .

Leucospis is our most generalized group of Chalcididæ so far as its wings are concerned. The wings of Chalcididæ show a close relation to those of Cynipidæ through *Leucospis* in the one group and *Ibalia* in the other.

On motion of Dr. E. P. Felt, the Secretary was instructed to send a message of sympathy and greeting to Dr. John B. Smith.

The society adjourned at 4:30 p. m., to meet Wednesday, December 27, at 10:00 a. m.

The annual business meeting was held by the society upon reconvening, and the following reports were presented:

The report of the Committee on Nomenclature was presented by Dr. H. T. Fernald. The report was ordered accepted and printed.

REPORT OF THE COMMITTEE ON NOMENCLATURE.

There have been no specific problems brought to the attention of your committee during the past year. The recommendations and suggestions submitted by the committee a year ago, are still before the Society, and we would suggest that they should come up for discussion and be voted upon. During the year various proposals for the reform of nomenclatorial practice have been discussed in public and private. One writer proposes a system of numbers to take the place of specific names. In another quarter there is a disposition to propose an entomological code to be independent of the international code of zoological nomenclature. Your committee is strongly of the opinion that the international code should be followed by all entomologists and is herein in hearty accord with the attitude of the last International Entomological Congress. It is desirable to determine the attitude of American entomologists on this important matter, and we would suggest that the question be discussed and voted upon at this meeting. It is to be observed that the adoption of the international code does not prevent entomologists from formulating and urging upon the zoological committee and congress, amendments designed to remove existing ambiguities and difficulties.

The question of *nomina conservanda* is now being discussed by the zoological committee and by zoologists generally. It is one which should not be lightly settled one way or the other, and we commend the matter to the society for discussion.

It is to be remarked that conformity with proper usages in writing and publishing would reduce the number of nomenclatorial problems, and it is a question (not wholly within the scope of your committee) whether the society should not formulate and adopt rules for the guidance of its members.

Respectfully submitted.

E. P. FELT,

H. T. FERNALD,

THEO. D. A. COCKERELL,

Committee.

Dr. H. T. Fernald also presented the following separate report prepared by Professor T. D. A. Cockerell, with which the other members of the Committee did not concur. It was ordered accepted and printed. This report was as follows:

REPORT PRESENTED BY PROFESSOR T. D. A. COCKERELL.

When a long-forgotten or ignored type-designation is found to seriously disturb the status of a well-known genus, the International Committee may *arbitrarily* select a type from among the originally included species, in such manner as to retain the generic name with its customary significance; Provided, that such designation be published six months before the next congress, and voted upon in open meeting at the congress.

This was especially suggested by the discovery that apparently, by strict application of the type-designation rule, *Colletes* must be called *Andrena*, with resulting confusion awful to contemplate.

The Committee on Resolutions presented the following report:

REPORT OF THE COMMITTEE ON RESOLUTIONS.

WHEREAS, The types of insect genera and species must of necessity be the basis of all future taxonomic work; and

WHEREAS, There is no general uniformity in the selection, labeling, and disposition of types among American entomologists and institutions; neither is there any uniformity of practice among custodians of types in reference to their availability for study; therefore, be it

Resolved, That a special committee of three be appointed to investigate the matter and others of similar import and make suitable recommendations at a subsequent meeting; and be it further

Resolved, That we express to the authorities of the United States National Museum and those of the Cosmos Club our deep appreciation of the many courtesies extended this organization.

Resolved, That we commend the editorial management of the *ANNALS* of the Entomological Society of America and hereby express our sense of great obligation to Professor Osborn for his part in the undertaking.
Respectfully submitted,

E. P. FELT,
E. D. BALL,
R. A. COOLEY.

Committee.

The Committee on Nominations presented the following list of officers for 1912:

President, S. A. Forbes.
1st Vice-President, A. D. Hopkins.
2d Vice-President, C. P. Gillette.
Secretary-Treasurer, A. D. MacGillivray.

Additional Members of Executive Committee, J. H. Comstock, John B. Smith, Henry Skinner, Herbert Osborn, E. D. Ball, P. P. Calvert.

Member of Committee on Nomenclature for three years, H. T. Fernald.
Respectfully submitted,

C. W. JOHNSON,
J. G. SANDERS,
H. E. SUMMERS.

Committee.

On motion, the secretary was instructed to cast a single ballot for the officers named. They were declared elected.

The Committee to Draft Resolutions on the death of Henry Ulke, consisting of A. D. Hopkins, E. A. Schwarz, and L. O. Howard, reported. The report was accepted and ordered printed.

The Committee to Draft Resolutions on the death of Samuel Hubbard Scudder, consisting of W. J. Holland and C. J. S. Bethune, were not in attendance. It was ordered that these resolutions be filed with the secretary and be included in the minutes.

The secretary presented the following report for the Executive Committee, which met at the Cosmos Club Tuesday evening, December 26:

REPORT OF THE EXECUTIVE COMMITTEE.

The following have died during the year:

Coquillett, D. W.	Ulke, Henry.
McCook, H. C.	Weems, Mrs. R. A. D.
Scudder, S. H.	

The following new members were elected by the Executive Committee in June, 1911:

Barrows, W. M.	Smith, Miss Lucy W.
Crampton, G. C.	Tsou, Y. H.
Rutherford, A.	Wallis, J. B.
Sherman, J. D., Jr.	

The following new members were elected by the Executive Committee last evening:

Baker, A. C.	Knight, H. H.
Carmody, Miss Mary.	McIndoo, N. E.
Ely, C. R.	Peterson, Alvah.
Fracker, S. B.	Ruth, W. A.
Funkhouser, W. D.	Sanford, H. L.
Glasgow, Hugh.	Timberlake, P. H.
Glasgow, R. D.	Urbahns, T. D.
Illingworth, J. F.	Varrelman, F. A.
Jobbins-Pomeroy, A. W.	Williamson, W.
King, Vernon.	

The following resignations were accepted and their membership terminated:

Adams, C. F.	McCray, A. H.
Bowditch, F. C.	Montgomery, C. E.
Brooks, Theo.	Murtfeldt, Miss M. E.
Brown, T. E.	Sala, August.
Denton, W. D.	Saunders, Dr. Wm.
Devereaux, W. L.	Slater, Miss F. W.
Frost, H. L.	Smith, H. G.
Hart, W. O.	Strong, W. O.
Hitchings, E. F.	Walton, W. R.
Lovell, J. H.	

The secretary presented a list of twenty names of persons who had been dropped by the secretary for non-payment of dues for two years.

The following recommendations were offered:

That members dropped for non-payment of dues shall be required to pay the full subscription rate, three dollars, during the full period of their retirement, in case they wish the *ANNALS*.

That members who have been dropped for non-payment of dues shall only be eligible for re-election to the society on payment of dues at time they were dropped.

That the Secretary-Treasurer and Professor J. H. Comstock be appointed a committee to deposit the fees of life members in a bank that they consider safe at a good rate of interest.

That the interest on fees of life members be considered an income.

That the Editor of the *ANNALS* be empowered to get the necessary clerical help that he needs in getting out the *ANNALS*.

That the publications presented to the Society by Dr. S. H. Scudder be sold and the net proceeds be added to the permanent fund.

The following amendments and additions to the By-Laws were recommended:

To amend By-Law 1, which now reads, "The annual dues for members and fellows shall be one dollar," to read:

1. The annual dues for members and fellows shall be two dollars; includes a subscription to the *ANNALS* of the Entomological Society of America.

The following additional By-Laws:

7. Members two years in arrears shall be dropped from the rolls of the society after twenty days notice.

8. A member elected shall not be in good standing until he pays his first year's dues. In case he shall not have made such payment at the expiration of one year from the date of his election, he shall be dropped from the roll by the secretary after twenty day's notice.

9. The *ANNALS* of the Entomological Society of America will not be mailed to any fellow or member whose dues and subscription are not paid on or before March 1.*

The Treasurer presented the following report:

Balance forward.....	\$ 252.49
Life membership fees.....	100.00
Cash received from Herbert Osborn.....	179.56
Cash collected as dues.....	1,004.84
Interest on fees of life members.....	5.75
	<hr/>
	\$1,542.64
Bills paid.....	740.21
	<hr/>
	\$ 802.43
Life membership fees and interest on same to July 1, 1911, deposited in Rothschild Bros. Savings Bank, Ithaca, N. Y., at 4%.....	\$105.75
Cash deposited to the credit of the Society in the First National Bank of Champaign, Ill.....	696.60
	<hr/>
	\$ 802.35

On motion, the report of the Executive Committee was adopted.

The Secretary called attention to the fact that certain amendments to the Constitution, recommended to the Society at the Boston meeting, had not been acted upon at the Minneapolis meeting. These were ordered read:

Article IV. Section 1. The officers of this Society shall be a President, two Vice-Presidents, and a Secretary-Treasurer. The duties of these officers shall be those usually pertaining to their respective offices.

*The wording of this By-Law as submitted at Washington is ambiguous. The following wording was submitted to the Executive Committee and by them adopted:

9. The *ANNALS* of the Entomological Society of America will not be mailed to any fellow or member whose dues are in arrears. All dues are payable December 1st, and should be received not later than March 1st.

To be amended to read:

Section 1. The officers of this Society shall be a President, two Vice-Presidents, a Secretary, and a Treasurer, but these two last offices may be held by the same person. Adopted.

Article IV. Section 2. The business of the Society not otherwise provided for shall be in the hands of an Executive Committee consisting of the officers named in Section 1, and of six additional members, who shall be elected from the Fellows of the Society. Four members of the committee shall constitute a quorum.

To be amended to read:

Section 2. The business of the Society not otherwise provided for shall be in the hands of an Executive Committee, consisting of the officers named in Section 1, and of six additional members, five of whom shall be elected from the Fellows by the Society, and the sixth shall be *ex officio* the Managing Editor. Four members of the Committee shall constitute a quorum. Adopted.

Article IV. Section 3. The President shall represent the Society upon the Council of the American Association for the Advancement of Science until such time as the Society shall be qualified for representation by two councillors, in which case the second councillor shall be elected from the fellows by the Executive Committee.

To be amended to read:

Section 3. Councillors to the American Association. The President and the preceding Past-President shall represent the Society upon the Council of the American Association for the Advancement of Science.

Referred back to the Executive Committee for further consideration.

The Managing Editor of the ANNALS presented his report, which was accepted. The editor pointed out the flourishing condition of the ANNALS, that the present volume would contain over five hundred pages, and that the number of societies and libraries subscribing was increasing each year.

Dr. Henry Skinner, the delegate of the Society to the First International Entomological Congress, held in Brussels, August 3-6, 1910, presented the following statement:

The First International Entomological Congress was held in Brussels August 3 to 6, 1910, and was very successful, about 137 members and 32 ladies—wives of members—being

present. (There were in all 270 memberships, which number includes museums, universities, and other scientific societies.) The memoirs of the First Congress have appeared, with 41 papers and 520 pages. There were but three persons present from the United States, and one from Canada. It is to be hoped that Americans will take greater interest in the next congress, which will be held in Oxford, England, this year from the fifth to the tenth of August. It promises to be even more successful and interesting than the first, and will afford an unusual opportunity for American entomologists to meet their European brothers under pleasant circumstances. It will also enable them to visit the various museums of England, and the continent, if they so desire. Anybody who takes an interest in any branch of entomology, scientific or applied, may become a member of the Congress. The membership fee will be five dollars. The expense of going to Oxford may be made small or great, according to the tastes or the comparative finances of the individuals attending. The study of entomology has become of very great importance to the world, and the first congress attracted much attention and favorable comment. The advance of entomology in America has been very great, and it is the duty of American entomologists to help advance the study throughout the world, and this they can do by aiding in the work of the next entomological congress.

Dr. P. P. Calvert moved the following resolution, which was seconded by Professor J. H. Comstock:

That the Entomological Society of America strongly recommend to the Second International Entomological Congress the preparation of lists of *nomina conservanda* in the various groups of insects, such names to be adopted irrespective of the strict rule of priority.

This resolution was discussed by Messrs. A. N. Caudell, W. D. Pierce, E. P. Felt, and P. P. Calvert. The motion was lost, 16 affirmative and 31 negative.

The auditing Committee presented the following report, which was adopted:

REPORT OF AUDITING COMMITTEE.

The Auditing Committee examined the accounts of the Secretary-Treasurer, and found them correct, in accordance with the appended report.

Respectfully submitted,

HENRY SKINNER,

A. D. HOPKINS,

J. H. COMSTOCK,

Committee.

The following resolution was introduced by Dr. E. P. Felt:

That the Entomological Society of America place itself on record in favor of delegate action at the International Congress of Entomology. Adopted.

It was then moved by Dr. J. Chester Bradley that the report of the Committee on Nomenclature presented at the Minneapolis meeting be taken up, section by section, at this time, for action. Adopted. (This report was printed in the ANNALS, Vol. IV, pp. 89-91. The sections refer to the numbered parts beginning near the bottom of page 90.) Section 1 was read and adopted. Section 2 was read, discussed by Messrs. Banks and Rehn, and on motion the Society passed to the consideration of Section 3. Section 3 was read, and after considerable discussion was ordered laid on the table for one year.

The following papers were then read:

F. M. Webster. *Our present educational system in relation to the training of economic entomologists.* The demand for trained men capable of engaging in entomological work has increased greatly, but the graduates of the colleges generally are not sufficiently equipped for such work and must have a special training of one to two years before they are available. The author wishes to emphasize the necessity for training in related sciences, in modern languages, and especially in field observation in entomology. The student intending to be an entomologist should begin in his first year with field observations and should be required to gather his own material for study. It would be especially desirable that students training for entomological work should have an experience at least during their vacations in work in some experiment station, and this sort of work should very properly be given credit in the college or university as part of the requirements leading to a degree.

C. W. Johnson. *The use of color in designating types and varieties.* Colored labels for types are being carried to an extreme. At the last meeting of the Cambridge Entomological Club one of our members who makes a specialty of printing labels for entomologists, asked me "what is an allotype, a homotype, a metotype, an autotype, and a topotype, and why don't they use the same color for the same kind of a type? One wants his paratype on light green, another on pink, and a third on brown. Why I can't get enough colors to go around."

energetic collector with time and money at his disposal can make some sort of a type out of seventy-five percent of his species. These various types may have some value, but they cannot always be depended upon. A great number of colors used indiscriminately is very confusing, for there are equally important features that might be designated by color, aside from manufactured types. Colors could be used to advantage to indicate abnormalities, especially today when the experimental biologist is after data as to the number and kinds of abnormalities that occur in specimens in nature. Such specimens are completely overlooked unless they are marked in some way. Not more than two colors should be used for types, red, for the primary, and green, for supplementary types. Then another color, yellow, for instance, could be used for abnormalities.

Herbert Osborn. *A problem in the flight of insects.* (Printed in this number of ANNALS.)

E. P. Felt. *The biology of Miaster and Oligarces.* The widely distributed *Miaster* larvæ reproduce by paedogenesis in the moist, decaying bark of various trees during fall and spring, midges appearing from June till August. A larval generation occupies 3 to 3½ weeks. *Oligarces* is less common than *Miaster*. Both are subject to attack by a number of natural enemies.

Leonard Haseman. *Entomological work in Missouri.* Since the early masterly work of Dr. C. V. Riley, the entomological needs of Missouri have not been properly served. Every line of entomological work is open for study. This department is investigating the more urgent insect problems of Missouri, though it is much handicapped by lack of assistance. The work connected with the instruction, station, nursery inspection, and duties of State Entomologist is more than the present staff can properly handle.

W. L. W. Field. *Hybrid butterflies of the Genus Basilarchia.* Since the Boston meeting two years ago, considerable progress has been made in the experiments with the supposedly hybrid *Basilarchias*, *B. prosperpina* Edw. and *B. arthechippus* Scud. Their hybrid nature has now been proven by breeding experiments. The data obtained also support the conclusions drawn from earlier experiments, to the effect that in *proserpina* the black of *astyanax* is incompletely but uniformly dominant over the white-banded condition of *arthemis*.

O. A. Johannsen. *Cocoon making of Bucculatrix canadensisella*. Read by title.

J. G. Needham. *Some adaptive features of myrmeleonid venation*. Read by title.

E. H. Strickland. *The Pesomachini of North America*. Read by title.

P. P. Calvert. *Seasonal collecting in Costa Rica*. Read by title.

Z. P. Metcalf. *Homologies of the wings veins of Homopter Auchenorrhynchi*. Read by title.

On motion, the President was authorized to name a committee of three on types, as suggested in the report of the Committee on Resolutions, this committee to report at the next annual meeting.

The following committee was named: T. D. A. Cockerell, Henry Skinner, and L. O. Howard.

On motion, the Society adjourned to meet in one year with the American Association for the Advancement of Science at Cleveland, Ohio.

Since the Washington meeting:

The President has named John B. Smith, L. O. Howard, E. P. Felt, W. E. Britton, and W. M. Wheeler, to represent the Society as delegates to the Centennial of the Academy of Natural Science of Philadelphia, Pennsylvania, held Tuesday, Wednesday, and Thursday, the 19th, 20th, and 21st of March, 1912.

The Executive Committee has named Herbert Osborn as the additional Councillor of the American Association for the Advancement of Science.

The Executive Committee has named the following delegates to the Second International Congress of Entomologists, to be held at Oxford, England, August 5th to 10th, 1912: Herbert Osborn, P. P. Calvert, Henry Skinner, J. H. Comstock, Vernon L. Kellogg, W. J. Holland.

ALEX. D. MACGILLIVRAY,
Secretary.

The Society is indebted to *Psyche* for the use of the plate of Dr. Scudder, and to *Entomological News* for the plate of Dr. McCook.—[EDS.]

ENTOMOLOGICAL SOCIETY OF AMERICA.

Organized 1906.

OFFICERS FOR 1912.

President.

STEPHEN A. FORBES.....University of Illinois, Urbana, Ill.

First Vice-President.

1). HOPKINS.....Bureau of Entomology, Washington, D. C.

Second Vice-President.

P. GILLETTE, Colorado Agricultural Exper. Sta., Fort Collins, Colo.

Secretary-Treasurer.

ALEX. D. MACGILLIVRAY.....University of Illinois, Urbana, Ill.

ADDITIONAL MEMBERS OF EXECUTIVE COMMITTEE.

J. H. COMSTOCK, Cornell University, Ithaca, N. Y.

J. B. SMITH, New Jersey Agricultural Experiment Station,

New Brunswick, N. J.

HENRY SKINNER, Academy of Natural Science, Philadelphia, Pa.

HERBERT OSBORN, Ohio State University, Columbus, O.

E. D. BALL, Director Utah Agricultural Experiment Station, Logan, Utah.

P. P. CALVERT, University of Pennsylvania, Philadelphia, Pa.

COMMITTEE ON NOMENCLATURE.

E. P. FELT, New York State Entomologist, Albany, N. Y.

Term expires 1912.

T. D. A. COCKERELL, University of Colorado, Boulder, Colo.

Term expires 1913.

H. T. FERNALD, Massachusetts Agricultural College, Amherst, Mass.

Term expires 1914.

COUNCILORS FOR THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

STEPHEN A. FORBES, University of Illinois, Urbana, Ill.

HERBERT OSBORN, Ohio State University, Columbus, O.

EDITORIAL BOARD OF ANNALS.

HERBERT OSBORN, Managing Editor, Ohio State University,

Columbus, O.

J. H. COMSTOCK, Cornell University, Ithaca, N. Y.

C. J. S. BETHUNE, Ontario Agricultural College, Guelph, Ont.

C. W. JOHNSON, Boston Society of Natural History, Boston, Mass.

V. L. KELLOGG, Leland Stanford Jr. University, Stanford University, Cal.

L. O. HOWARD, Chief, Bureau of Entomology, Washington, D. C.

W. M. WHEELER, Harvard University, Cambridge, Mass.

P. P. CALVERT, University of Pennsylvania, Philadelphia, Pa.

J. W. FOLSOM, University of Illinois, Urbana, Ill.

OFFICERS FOR THE YEAR 1907.

President.....	PROF. J. H. COMSTOCK
First Vice President.....	DR. JAMES FLETCHER
Second Vice President.....	DR. HENRY SKINNER
Secretary-Treasurer.....	MR. J. CHESTER BRADLEY

Additional Members of the Executive Committee:

DR. W. M. WHEELER, DR. J. B. SMITH, PROF. C. J. S. BETHUNE,
 PROF. HERBERT OSBORN, MR. F. M. WEBSTER, MR. C. W. JOHNSON.

OFFICERS FOR THE YEAR 1908.

President.....	DR. W. M. WHEELER
First Vice President.....	DR. J. B. SMITH
Second Vice President.....	PROF. C. J. S. BETHUNE
Secretary-Treasurer.....	MR. J. CHESTER BRADLEY

Additional Members of the Executive Committee:

PROF. J. H. COMSTOCK, DR. J. G. NEEDHAM, DR. P. P. CALVERT,
 PROF. HERBERT OSBORN, MR. F. M. WEBSTER, PROF. V. L. KELLOGG.

OFFICERS FOR THE YEAR 1909.

President.....	DR. HENRY SKINNER
First Vice President.....	PROF. HERBERT OSBORN
Second Vice President.....	DR. A. D. HOPKINS
Secretary-Treasurer.....	MR. J. CHESTER BRADLEY

Additional Members of the Executive Committee:

PROF. J. H. COMSTOCK, DR. JOHN B. SMITH, DR. W. M. WHEELER,
 PROF. C. J. S. BETHUNE, MR. E. A. SCHWARTZ, PROF. LAWRENCE BRUNER.

OFFICERS FOR THE YEAR 1910.

President.....	DR. JOHN B. SMITH
Vice President.....	DR. S. A. FORBES
Second Vice President.....	PROF. V. L. KELLOGG
Secretary-Treasurer.....	PROF. C. R. CROSBY

Additional Members of the Executive Committee:

PROF. J. H. COMSTOCK, MR. E. A. SCHWARTZ, PROF. C. J. S. BETHUNE,
 DR. W. M. WHEELER, PROF. J. M. ALDRICH, PROF. LAWRENCE BRUNER

OFFICERS FOR THE YEAR 1911.

President.....	PROF. HERBERT OSBORN
First Vice President.....	PROF. LAWRENCE BRUNER
Second Vice President.....	PROF. A. D. MACGILLIVRAY
Secretary-Treasurer.....	PROF. A. D. MACGILLIVRAY

Additional Members of the Executive Committee:

PROF. J. H. COMSTOCK, PROF. C. J. S. BETHUNE, DR. H. SKINNER,
 DR. J. B. SMITH, DR. W. M. WHEELER, DR. A. D. HOPKINS.

CONSTITUTION.

ARTICLE I.

NAME.

SECTION 1. This organization shall be known as THE ENTOMOLOGICAL SOCIETY OF AMERICA.

ARTICLE II.

OBJECT.

SECTION 1. It shall be the purpose of this society to promote the science of entomology in all its branches, to secure cooperation in all measures tending to that end, and to facilitate personal intercourse between entomologists.

ARTICLE III.

MEMBERSHIP.

SECTION 1. The membership of this society shall consist of three classes—members, fellows, and honorary fellows.

SEC. 2. All persons interested in entomology shall be eligible to membership.

SEC. 3. Members who have made important contributions to the science of entomology may be elected fellows or honorary fellows of the society.

ARTICLE IV.

OFFICERS.

SECTION 1. The officers of this society shall be a President, two Vice-Presidents, a Secretary, and a Treasurer; but these two last offices may be held by the same person.

SEC. 2. The business of the society not otherwise provided for shall be in the hands of an executive committee, consisting of the officers named in Section 1, and of six additional members, five of whom shall be elected from the Fellows by the Society, and the sixth shall be *ex officio* the Managing Editor. Four members of the Committee shall constitute a quorum.

SEC. 3. The president shall represent the society upon the Council of the American Association for the Advancement of Science until such time as the society shall be qualified for representation by two councillors, in which case the second councillor shall be elected from the fellows by the Executive Committee.

ARTICLE V.

ELECTIONS.

SECTION 1. Election of Members—Nominations for membership may be made by any two members, and election shall be by the Executive Committee.

SEC. 2. Election of Fellows—All nominations for fellow shall be signed by three or more fellows and each nomination shall be accompanied by the following information concerning the nominee: Name, address, occupation, branches of entomology engaged in, positions held involving entomological experience, entomological work done, and list of more important publications. Election shall be by ballot by the Executive Committee, a majority vote of the committee being necessary for election.

SEC. 3. Election of Officers—All officers shall be elected by ballot at the annual meeting for the term of one year and shall be eligible for re-election. Their term of office shall commence with the first of June following their election.

SEC. 4. Election of Honorary Fellows—All nominations for Honorary Fellows shall be made in the manner prescribed for the nomination of Fellows, the nominations being presented to the Executive Committee, who shall mail the ballots to the Fellows. Election shall be by mail ballot of the Fellows of the Society, a two-thirds vote of all the Fellows being required for election.

ARTICLE VI.

MEETINGS.

SECTION 1. An annual meeting shall be held in conjunction with the annual meeting of the American Association for the Advancement of Science, and at such time and place as the officers may elect.

ARTICLE VII.

AMENDMENTS.

SECTION 1. This constitution may be altered or amended at any annual meeting by a two-thirds vote of the members present, a copy of each amendment proposed having been presented at the previous annual meeting.

BY-LAWS.

1. The annual dues for members and fellows shall be two dollars. This includes a subscription to the *Annals of the Entomological Society of America*.
2. A majority of the members present at any annual meeting shall constitute a quorum for the transaction of business.
3. Notice of all meetings of the society shall be sent to all members at least one month in advance.
4. The Executive Committee shall provide a program for all meetings, including at the annual meeting a popular lecture and a technical entomological exhibit of materials and methods.
5. The time of the business session shall be published prior to the opening session of the annual meeting.
6. Any member may become a life member upon payment of \$50 at one time, and shall be exempt from further assessments. He shall receive during his life one copy of each issue of the *Annals*.
7. Members two years in arrears shall be dropped from the rolls by the Secretary-Treasurer after twenty days notice.
8. A member-elect shall not be in good standing until he pays his first year's dues. In case he shall not have made such payment at the expiration of one year from the date of his election, he shall be dropped from the roll by the Secretary-Treasurer after twenty days notice.
9. The *Annals of the Entomological Society of America* will not be mailed to any fellow or member whose dues are in arrears. All dues are payable December 1st, and should be received not later than March 1st.

MEMBERSHIP OF THE SOCIETY.

HONORARY FELLOWS.

CRESSON, EZRA TOWNSEND, Hedgely, Swarthmore, Pa. *Aug.*, '07.

UHLER, DR. PHILIP REESE, 254 W. Hoffman St., Baltimore, Md.

Aug., '07

FELLOWS.

ALDRICH, PROF. J. M., University of Idaho, Moscow, Idaho. *Aug.*, '07

BALL, PROF. E. D., Director. Agr. Exper. Sta., Logan, Utah. *Dec.*, '08.

BETHUNE, DR. C. J. S., Ont. Agr. College, Guelph, Ont. *Dec.*, '06.

BEUTENMÜLLER, W., 879 Whitlock Av. Bronx, New York, N. Y. *Aug.*, '07.

BRUNER, PROF. LAWRENCE, Univ. of Nebraska, Lincoln, Neb. *Dec.*, '07.

CALVERT, DR. P. P., Univ. of Pennsylvania, Philadelphia, Pa. *Aug.*, '07.

COCKERELL, PROF. T. D. A., Univ. of Colorado, Boulder, Colo. *Dec.*, '08.

COMSTOCK, PROF. J. H., Cornell University, Ithaca, N. Y. *Dec.*, '06.

DYAR, DR. H. G., U. S. Nat. Museum, Washington, D. C. *Aug.*, '07.

EMERTON, J. H., 194 Clarendon St., Boston, Mass. *Aug.*, '07.

FALL, PROF. H. C., 191 N. Raymond Ave., Pasadena, Cal. *Dec.*, '07.

FELT, DR. E. P., N. Y. State Entomologist, Albany, N. Y. *Dec.*, '08.

FERNALD, PROF. C. H., Mass. Agr. College, Amherst, Mass. *Aug.*, '07.

FOLSOM, DR. J. W., Univ. of Illinois, Urbana, Ill. *Dec.*, '07.

FORBES, PROF. S. A., Univ. of Illinois, Urbana, Ill. *Aug.*, '07.

GILLETTE, PROF. C. P., Colorado Agr. College, Fort Collins, Colo.

Dec., '07.

HENSHAW, SAMUEL, Harvard University, Cambridge, Mass. *Aug.*, '07.

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 JENNINGS, H. R., Parkville, Mo. Dec., '10.
 JENSEN, JESSE O., Eagle Bend, Minn. Dec., '08.
 JOBBINS-POMEROY, A. W., Nat. Hist. Bldg., Urbana, Ill. Dec., '11.
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